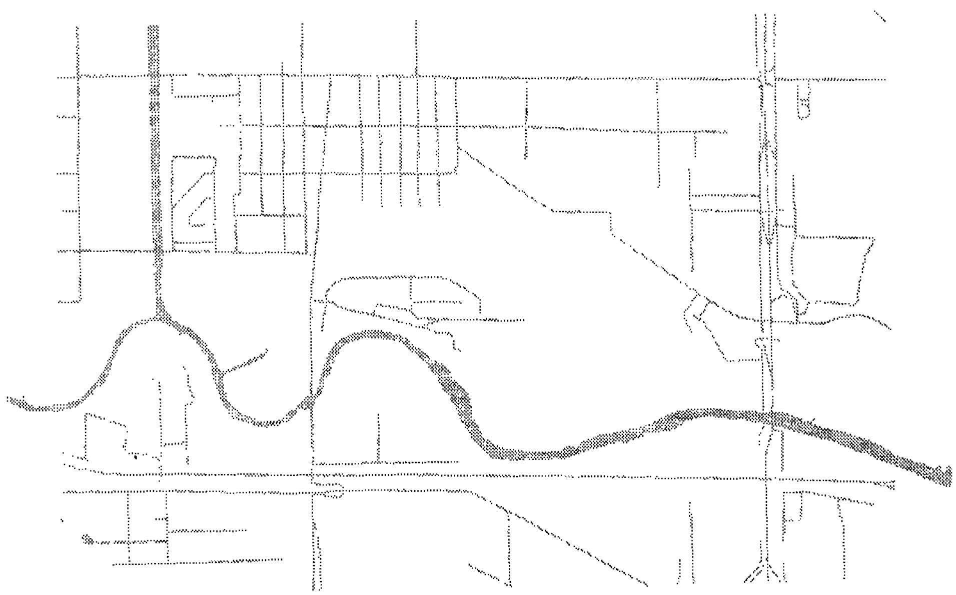
Current Conditions Report for the DuPont East Chicago Facility

Volume 1



Prepared for

DUPONT E.I. du Pont de Nemours and Company

Prepared by

CH2MHILL

IND 005 174 354

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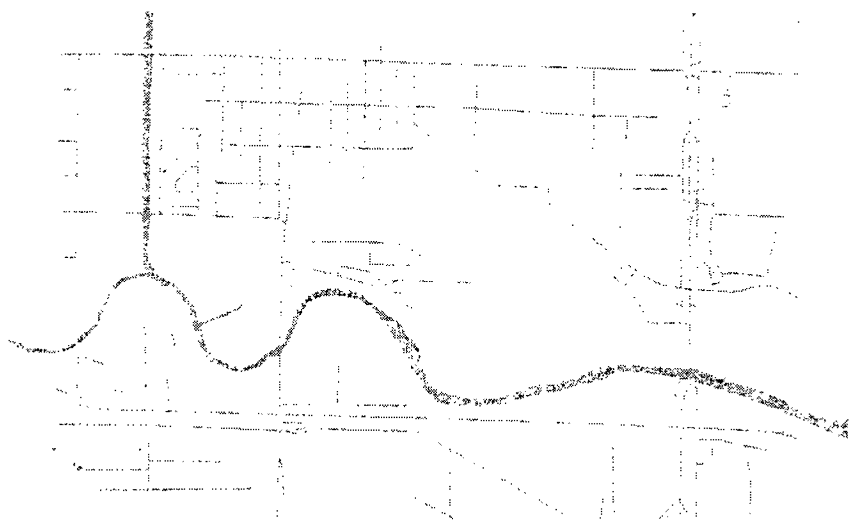
Volume 1



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October 1997

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DUPONT®

DuPont Specialty Chemicals

October, 28, 1997

U.S. EPA, Region 5
Waste Pesticide and Toxics Division
Enforcement and Compliance Assurance Branch
77 West Jackson Boulevard, DRE-8J
Chicago, IL 60604-3590

Attn: DuPont-East Chicago Project Coordinator

RE: **Current Conditions Report**

Dear Mr. Wojtas::

Pursuant to RCRA Corrective Action Order IND 005 174 254, DuPont is enclosing three (3) copies of the Current Conditions Report and associated appendices for your review. Additional copies of the reports have been submitted to Kurt Whitman (TetraTech EM, Inc.) and the Indiana Department of Environmental Management (IDEM). We look forward to discussing the Current Conditions Report with EPA and IDEM in several weeks.

If you have any questions please feel free to call David Epps at (302) 992-6592.

Sincerely,

J. Hilton Frey
Project Director

c: Chris Myer, IDEM (4 copies, 2 sets of appendices)
Kurt Whitman, TetraTech EM, Inc. (1 copy, 1 set of appendices)
Bernie Reilly, DuPont (1 copy w/o appendices)
Kathy Shelton, DuPont (1 copy w/o appendices)
File

Enclosures (3)

CERTIFICATION

Pursuant to section XV of the RCRA Corrective Action Order, the following certification is provided:

> "I certify that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to evaluate the information submitted. I certify that the information contained in or accompanying this submittal is true, accurate, and complete. As to those identified portions of this submittal for which I cannot personally verify the accuracy, I certify that this submittal and all attachments were prepared in accordance with procedures designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those directly responsible for gathering the information or the immediate supervisor of such person(s), the information submitted is, to the best of my knowledge and belief true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations"

Signature: J Hilton Frey

Name: J Hilton Frey

Title: Project Director

Date: 10/28/97

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Executive Summary

This Current Conditions Report (CCR) summarizes available information on existing site conditions at the DuPont East Chicago facility and makes a preliminary evaluation of potential migration pathways and potential receptors. This baseline knowledge of the site will be used in developing the RCRA Facility Investigation (RFI) Work Plan in order to identify data needs and information gaps critical to proceeding with the next steps of the corrective action program and fulfilling the program objectives.

Corrective Action Program Objectives

The corrective action program establishes the framework for evaluating, and when necessary, remedying the releases of hazardous waste and hazardous constituents from solid waste management units (SWMUs) and areas of concern (AOCs) at a RCRA-permitted or interim status facility. U.S. EPA's corrective action goal is to control or eliminate risks to human health and the environment. The Agency's RCRA corrective action program objectives are as follows:

- Create a consistent, holistic approach to cleanups at RCRA facilities
- Establish practical but protective cleanup expectations
- Shift more of the responsibility for achieving cleanup goals to the regulated community
- Focus on opportunities to streamline and reduce costs, and
- Enhance opportunities for timely, meaningful public participation

DuPont has established an approach to corrective action based on U.S. EPA guidance. The RFI objectives are to identify releases to the environment from solid waste management units (SWMUs) and areas of concern (AOCs), and to determine whether any of those releases may pose a threat to human health or the environment. To meet these objectives, SWMUs and AOCs are systematically investigated until the two key objectives of the RFI are met. Depending on the nature of the waste managed in individual units, some units may pose a greater release potential than others. It is DuPont's belief that units posing the greatest threat of release or the greatest threat to human health and the environment should be given higher priority for investigation early in the RFI than other units.

Facility Setting and Physical Characteristics

The DuPont East Chicago facility is located within an area that has been a major urban industrial center since the early 1900s. Surrounding land uses consist primarily of industrial and commercial lands and interspersed residential areas.

Site development started in 1892 and included filling, regrading, and construction of manufacturing buildings, utilities, and roadways. Today the facility comprises four main areas: (1) the active manufacturing area; (2) the previously active manufacturing area; (3) waste management areas outside the manufacturing area; and (4) a natural area. Limited (if any) vegetative cover or habitat has existed historically within the developed part of the facility.

Because most former waste management areas have been inactive since the late-1970s, vegetation is re-establishing itself across those areas. All facilities in the previously active manufacturing area have been removed, although foundations, building rubble, and pavement are still visible.

Groundwater is present 0 to 10 feet below the land surface in the thin (30- to 40-foot) sand unit underlying the facility. Flow is downslope away from an east-west groundwater divide that runs through the center of the facility and limited by the presence of the East Branch of the Grand Calumet System to the south and a hydraulic divide in Riley Park to the north. All the groundwater that migrates south discharges to the waterway, although groundwater does not contribute significantly to the waterway's flow.

Lake Michigan is the source of domestic water supply for the City of East Chicago and surrounding communities (Hammond, Whiting, Gary). The shallow groundwater in the Calumet Aquifer is not used as a potable water supply. The bedrock aquifer, about 150 feet below ground, is used in a limited capacity for industrial water.

Facility History and Waste Management Practices

The East Chicago facility began operation in 1893 with the production of inorganic chemicals. Over its lifetime, the facility produced more than 100 products, including various inorganic chemicals, acids, Freon®, and some herbicides and insecticides. The facility now manufactures a colloidal silica product (Ludox®) and sodium silicate solution.

DuPont historically managed wastes at the facility according to general industry practices at the time. Process wastewaters were discharged to the East Branch of the Grand Calumet System. Today pretreated process wastewaters and stormwater are discharged through two NPDES-permitted outfalls. Before the early 1970s, general refuse, wastewater treatment filter cake, process filter cake, ash, and construction debris were managed onsite. Only one of these areas is still active, and that is a landfill operated under IDEM's solid waste program to manage filter cake from the wastewater treatment system.

Available information regarding current and historic materials and waste management areas and practices has been reviewed to identify SWMUs and AOCs that may be the sources of past releases. Based on this information, 22 SWMUs and 10 AOCs have been identified. The RFI Work Plan will be developed to determine which units have been the sources of releases and require further investigation under the corrective action process.

Environmental Quality

Before entering into the RCRA section 3008(h) Administrative Order on Consent, DuPont had conducted three phases of site investigations, which included sampling of soil, groundwater, and river bank water. The primary constituents detected in environmental media at the facility were inorganic compounds, with the most frequent detections being the major ions, water quality parameters (e.g., nitrates), and common metals that occur naturally in the environment. Many of these constituents were also primary components of products manufactured at the facility (e.g. aluminum, calcium chloride, fluoride, sulfate). Select trace metals that were also primary components of facility products (e.g., arsenic, barium, chromium, lead, and zinc) were detected at varying frequencies. Other trace metals present as trace components in products or waste streams (e.g., cadmium, nickel) were detected at low frequencies in samples of environmental media.

Organic compounds were rarely detected (at greater than 5 percent frequency) in the environmental media at the facility, with a few exceptions. The most noteworthy exception is Freon, which was found in both soil and groundwater in and near the former Freon manufacturing area.

Existing environmental quality data indicate the range of constituents present at the site and provide a very general overview of current conditions. Future evaluations may require additional data to develop a better understanding of conditions at potential sources, constituent mobility at the site, and, possibly, constituent concentrations at potential points of exposure.

Potential Migration Pathways and Potential Receptors

A preliminary evaluation of available information has not identified imminent threats to public health or the environment associated with the facility, but it has identified potential migration pathways and potential receptors associated with the site. Preliminary evaluation indicated that, of the three pathways identified, the pathway likely to be of greatest significance is the migration of dissolved constituents in groundwater, followed by surficial runoff of entrained particulates. Airborne transport of dust is the potential pathway of least concern.

Few plausible receptors could be affected by environmental quality conditions at the facility, with potential human receptors limited to some residents in the Riley Park area, infrequent trespassers in the natural area, and individuals who use the reach of the East Branch of the Grand Calumet System directly adjacent to the facility for recreation. Potential ecological receptors are limited to plant and animal species (including species of special status) that occur in or might use the natural area or the East Branch of the Grand Calumet System.

Considering the mitigating factors associated with the potential receptors, migration pathways, and potential constituents of interest, it is unlikely that significant concentrations of facility-related constituents could be present at receptor locations, or that significant contact with affected environmental media by receptors may be occurring.

RFI Work Plan Development

The next step in the corrective action process is to conduct an RFI of the SWMUs and AOCs identified in this CCR. Several tasks must be completed before submittal of the RFI Work Plan to assist in identifying the activities to be completed during the RFI. One such activity will be the evaluation of the SWMUs and AOCs as to whether a release from the unit or area has occurred. That evaluation will be based on existing data and knowledge of operations pertaining to SWMUs and AOCs. If sufficient information does not exist to determine the occurrence of a release, then additional data will be collected as part of the RFI. Upon determining if a release has occurred, specific criteria for prioritizing SWMUs and AOCs will be used to initiate further action. The RFI Work Plan will document these tasks and describe activities to be completed as part of the RFI. The work plan will be submitted to the

U.S. EPA in the first quarter of 1998. The activities delineated in the RFI Work Plan will be implemented upon approval by the U.S. EPA.

CHAPTER 1

Introduction

E. I. du Pont de Nemours and Company, Inc., is undertaking corrective action activities at its facility in East Chicago, Indiana (Figure 1-1). Those activities are being conducted pursuant to an Administrative Order on Consent under the authority of Section 3008(h) of the Resource Conservation and Recovery Act (RCRA). This Current Conditions Report (CCR) is the initial step in the RCRA corrective action process for the East Chicago facility. The CCR presents DuPont's understanding of site conditions based on a consolidation of existing information available for review.

RCRA Corrective Action and the Role of the CCR

Corrective Action Program Objectives

The corrective action program establishes the framework for evaluating, and when necessary, remedying the releases of hazardous waste and hazardous constituents from solid waste management units (SWMUs) and areas of concern (AOCs) at a RCRA-permitted or interim status facility.

According to the U.S. EPA, the fundamental goal in a corrective action program is to control or eliminate risks to human health and the environment given reasonable exposure assumptions and in a manner consistent with the degree of threat at a given facility. Recognizing that improvements to the original corrective action program are necessary, the U.S. EPA has developed the following RCRA corrective action program objectives:

- Create a consistent, holistic approach to cleanups at RCRA facilities
- Establish practical but protective cleanup expectations
- Shift more of the responsibility for achieving cleanup goals to the regulated community
- Focus on opportunities to streamline and reduce costs, and
- Enhance opportunities for timely, meaningful public participation

DuPont's approach to corrective action is based on U.S. EPA guidance for RCRA corrective action.

Role of the CCR and DuPont's Objectives

This CCR presents information available on current site conditions, makes a preliminary evaluation of potential migration pathways and potential receptors, and integrates that information into a preliminary conceptual model of the facility. This baseline knowledge of the site will be used to identify data needs and information gaps critical to proceeding with the next steps of the corrective action program. More specifically, the information presented herein will be used to establish the scope of a work plan for a RCRA Facility Investigation (RFI).

The objectives of the RFI are (1) to identify releases to the environment from solid waste management units (SWMUs) and areas of concern (AOCs) and (2) to determine whether any of those releases may pose a threat to human health or the environment. SWMUs and AOCs are systematically investigated until the two key objectives of the RFI are met.

Depending on the nature of the waste managed in individual units, some units may pose a greater release potential than others. It is DuPont's belief that units that pose the greatest potential for release or the greatest potential risk to human health and the environment should be given a higher priority for investigation early in the RFI than other lower priority units. The concept of prioritization is currently used by the U.S. EPA in the National Corrective Action Prioritization System (NCAPS), which has been used to prioritize RCRA Facility Investigations in each of the 10 U.S. EPA regions. The prioritization process uses risk management decision points, U.S. EPA guidance, and resource management to focus the investigative efforts during the RFI, and provides the basis for segregating SWMUs into high and low priorities to be addressed in a practical, proactive, and cost-effective manner.

CCR Organization

Chapter 2 presents information pertaining to the physical setting of northwest Indiana as a region and at the site. Chapter 3 summarizes the history of facility operations and waste management practices. It also presents the SWMUs and AOCs identified for the site. The current understanding of environmental quality conditions at the facility is provided in Chapter 4. Chapter 5 presents the preliminary conceptual model of the East Chicago facility. The model integrates what is known about physical and environmental quality conditions at the site, potential release, mechanisms affecting constituent mobility, potential migration pathways, and potential receptors. The model is based on existing information and will evolve as more information becomes available throughout the corrective action program.

Volume 2 of this report contains appendixes of supplemental information, such as raw analytical data and in-depth explanations of particular topics.

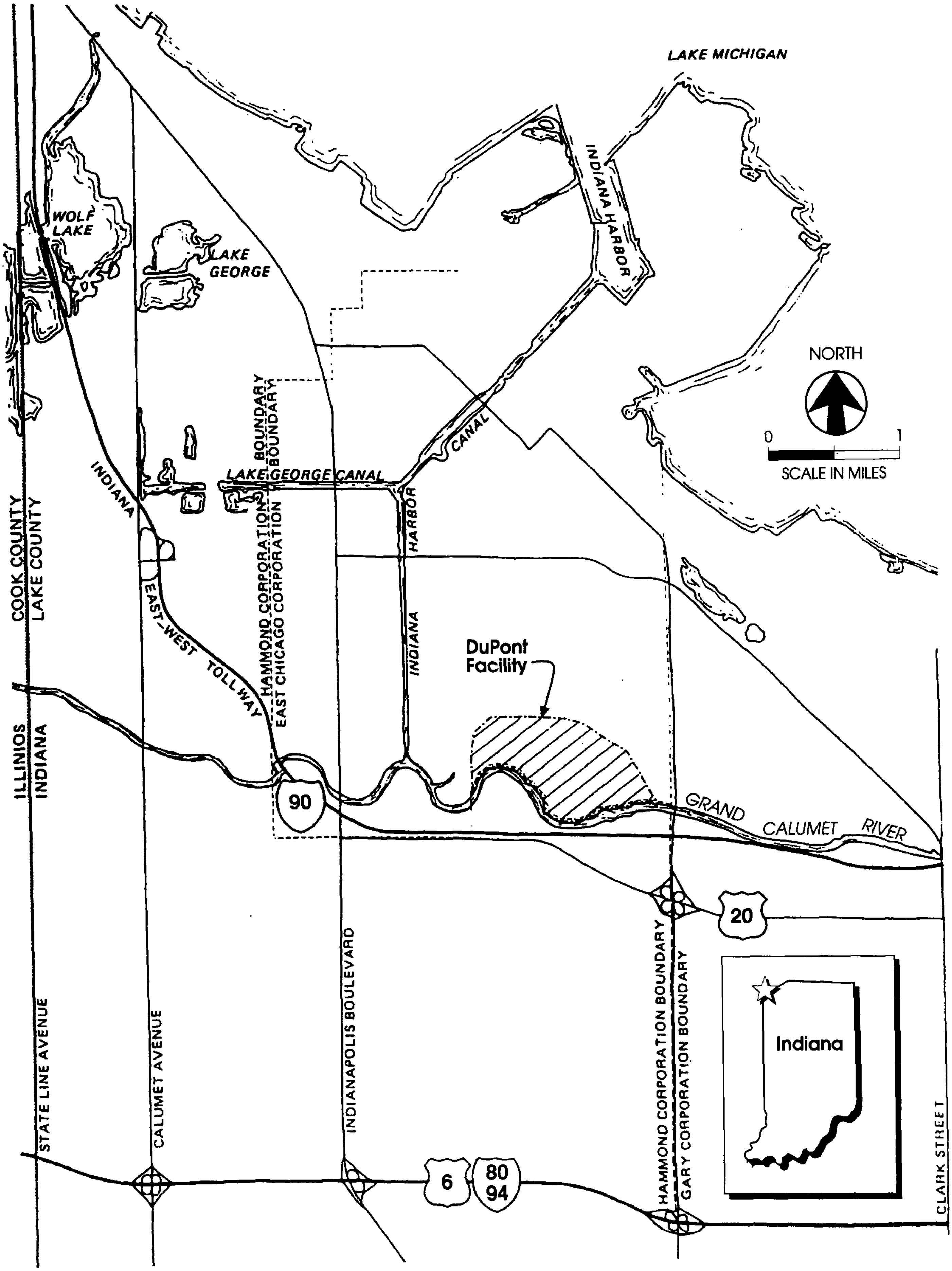

FIGURE 1-1
Site Location Map
DuPont East Chicago Current Conditions Report

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E142837.EC.CC Site Loc Map 10-13-97mms

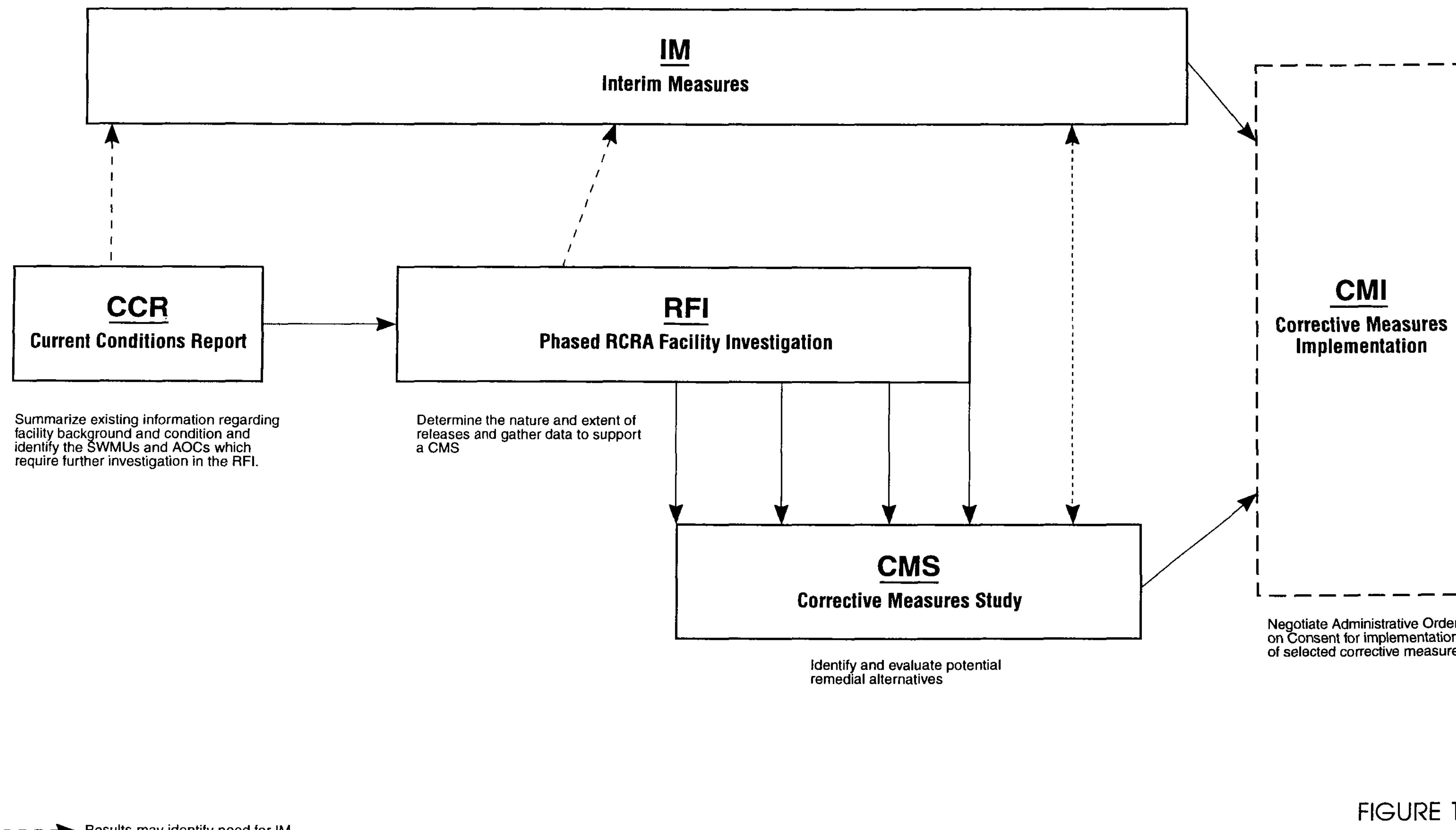

FIGURE 1-2
RCRA Corrective Action Process
DuPont East Chicago Current Conditions Report

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CHAPTER 2

Facility Setting and Physical Characteristics

This chapter contains relevant information regarding the facility setting and the physical characteristics of the site. The physical characteristics of both the region and the site have been investigated by a number of public agencies and private parties. As a result, some of the information typically collected during a RCRA Facility Investigation has already been collected by DuPont and others. Additional regional and site-specific information that will be of use when conducting future work at the property is contained in Volume 2 of this report.

Regional and Site Development Overview

Regional Location and Development

The DuPont East Chicago facility is located within an industrial region defined by Lake Michigan to the north, Interstate 94 to the south, the Indiana/Illinois border to the west, and the eastern edge of the City of Gary to the east (Figure 2-1). Industrial development in this region initially occurred between 1867 and 1920, when sites in Chicago became unavailable, forcing industry to expand eastward along the southern shore of Lake Michigan. The character of the region is not expected to change dramatically in the foreseeable future.

A timeline of industrial development within the region is shown in Figure 2-2. Some of the first industries to move into the region were the Aetna Power Plant near Miller in 1867, the National Fire Roofing Company in Hobart in 1881, and the Standard Oil Refinery in Whiting in 1889. Industrialization and urban development proceeded together from the late 1800s through the 1960s. Industries were drawn to the plentiful land, low taxes, extensive rail network, abundant water supply, and proximity to Chicago. Canals and deep water ports were constructed along Lake Michigan during this period.

Much of land in the region was unsuitable for development without filling and installation of site drainage. The Indiana General Assembly passed Indiana Code 4-18-13 in 1907, which encouraged the building of artificial land along the Indiana shoreline. Industrial expansion extended northward into Lake Michigan and inland, away from Chicago, using urban fill that consisted primarily of slag from the steel mills in the region.

Site Location and Development

The East Chicago facility is located at 5215 Kennedy Avenue, East Chicago, in Lake County, Indiana. DuPont owns about 440 acres at this address. Of these lands, roughly 430 acres are contiguous and constitute the "facility" for the purposes of the RCRA Corrective Program.

A chemical manufacturing facility was constructed at the site by the Grasselli Corporation in 1892. Development occurred primarily within the western part of the property. The southern part of the developed area was used for manufacturing purposes and is sometimes referred to as the primary manufacturing area. The northwestern quadrant of the property and the eastern edge of the developed area were used for waste management purposes. The eastern part of the property, sometimes referred to as the "natural area," has not been developed (Figure 2-3).

Surrounding Land Use

The southern shoreline of Lake Michigan, in northwestern Indiana, is one of the major urban industrial centers along the Great Lakes. Industries in the region include steel mills, manufacturing plants, heavy manufacturing associated with the steel industry, petroleum-related land uses, packaging, and chemical processing plants. Numerous petroleum storage facilities and railroad tracks serve the area surrounding the facility. The surrounding land use consists primarily of industrial and commercial lands with interspersed residential areas (Figure 2-4).

The property is bounded on the west by Kennedy Avenue, on the north and northeast by the Indiana Harbor Belt Railroad, on the east by the Chicago South Shore and South Bend Railroad and a property owned by the City of East Chicago, and on the south by the East Branch of the Grand Calumet System (see Volume 2 for a map showing the locations of adjacent property owners). Nearby properties are U.S.S. Lead to the west across Kennedy Avenue; a residential area (Riley Park), a salvage yard, a trucking facility, and a bulk petroleum tank farm to the north; a waste transfer station and city central services facility to the northeast and east; and Harbison-Walker Refractories, a metals facility (Halstab), and petroleum storage facilities to the south across the East Branch of the Grand Calumet System (Figure 2-5).

Numerous sites within the region have undergone or are undergoing investigation for remediation. Several are being remediated under regulatory programs (such as Superfund and RCRA Corrective Action Programs), voluntary cleanups, or brownfield initiatives (Table 2-1 and Figure 2-5). Others are regulated as hazardous waste generators, landfills, or TSD facilities (Table 2-1). The parties implementing these programs are industries, property owners, and agencies (e.g., the U.S. EPA, the Indiana Department of Environmental Management [IDEM], and the U.S. Army Corps of Engineers [COE]). In some cases, the work is being performed in cooperation with interest groups and trustees.

Topography, Drainage, and Surface Water Hydrology

Regional Topography and Drainage

With the exception of the land adjacent to Lake Michigan, the region lies within the Grand Calumet Basin (Figure 2-6). The Grand Calumet System drainage basin encompasses nearly 43,000 acres, according to the U.S. EPA's Grand Calumet Master Plan (1985). This estimate takes into consideration the area's sanitary and storm sewer systems and the divergence of flow in the West Branch of the Grand Calumet System.

The original topography of the region consisted of a series of beach ridges separated by swales, which were formed as Lake Michigan's shoreline receded to the north following the last stage of glaciation. The land was poorly drained. Marshy areas were prevalent. Uplands drained to nearby low-lying areas, many of which were not connected to area waterways.

As a result of many decades of industrial development, wet low-lying areas between ridges have been filled, ridges have been leveled, the land has been regraded, and the surface drainage patterns (Figure 2-6) have been altered. Few examples of the original ridge and swale topography remain in the region today, and drainage is now largely controlled by ditches and sewers.

Meteorology and Surface Water Hydrology

Meteorology

Northwestern Indiana receives a mean annual total precipitation of 35 inches, and has a daily average ambient temperature of 49 degrees. The average windspeed is 10 miles per hour, and the predominant wind direction is southwesterly (see Volume 2 for wind roses summarizing available wind direction information collected at the Gary Municipal Airport).

Surface Water Hydrology

The Grand Calumet System (which comprises the East Branch, West Branch, and Indiana Harbor Canal) is the predominant surface water feature within the region. In the early 1800s, the smaller natural river (referred to as the Grand Calumet River) flowed to the east, discharging to Lake Michigan in Gary. In the early 1900s, the Indiana Harbor Canal was dug between Lake Michigan and the river to provide a shipping canal for local industry. These modifications reversed the flow in the East Branch so that water in the original channel now flows to the west. Construction of the Indiana Harbor Canal and connection (in the West Branch) to the Illinois River Basin Sag System resulted in capture of water that would have drained east to Lake Michigan. Streamflow in the eastern part (the East Branch) of the Grand Calumet System was significantly decreased. The reduced flow, combined with the sand dune migration, resulted in the closure of the river's original outlet at Lake Michigan (about 10 miles east of the DuPont facility).

The course of the waterway also was modified. The channel was relocated in Gary during the construction of the U.S. Steel Gary Works facility and at several locations during the construction of I-90 in 1956. The latter activities affected the location of the waterway adjacent to DuPont property. As a result, the channel was shifted south and reinforced along the southeastern edge of the property (Figure 2-7). Evidence of filling along the northern channel on DuPont property can be seen in aerial photographs taken in the early 1960s.

Today, flow from the East Branch joins flow from the West Branch just west of the DuPont facility, at the southern end of the Indiana Harbor Canal. The canal conveys the combined flow north-northeast from there to Lake Michigan. The rate of flow to the lake is controlled by primarily industrial discharges and the relative elevation of surface water in the channel and lake (Fenelon and Watson 1993).

Backup of the waterway flow and temporary flow reversals have been observed in the East Branch of the Grand Calumet System. The magnitude and extent of the flow reversal depends on river stage and rainfall and varies over time. Lake level impacts on waterway stage have been observed to extend upstream in the East Branch from the southern end of the Indiana Harbor Canal (Fenelon and Watson 1993).

Shortly after the East Branch outlet was closed, this waterway's characteristics were dramatically altered. The channel became the primary conveyance system for effluent discharges from the industries and municipalities in the region. The maximum river flow in the East Branch occurred when the effluent discharges from industries along the waterway were at their highest levels (from the mid-1940s through the mid-1970s). The industries and municipalities discharging to the East Branch are listed Table 2-2 and shown, along with other dischargers to the Grand Calumet System, on Figure 2-8. Reductions in discharge have occurred over the last decade or so. Wasteload allocations computed in the 1980s were based on a total waterway flow of 900 mgd, while the total flow in the early 1990s was roughly 340 mgd (IDEM 1985; IDEM 1992) In 1996, more than 99 percent of the effluent discharge to the East Branch of the Grand Calumet System was from the U.S. Steel Gary Works facility and the Gary Sanitary District upstream of the DuPont facility (PTI 1997). The East Branch also receives intermittent discharges from storm drains and combined sewer overflows (CSOs) during significant rainfall events. Stormwater runoff represents only a small fraction of the flow within the waterway (see Volume 2 for additional information on flow within the East Branch).

Site Topography and Drainage

Topography in the developed part of site has been altered by filling and regrading. Soil, iron mill slag, sinters, and other fill materials were used to create a secure site foundation within the primary manufacturing area. Site relief varies from 584.5 to 590.5 feet above mean sea level, sloping gently (0.003 to 0.006 ft/ft) toward the south-southwest. There is a regional high of 600 feet (±5 feet) in an oval ridge at the center of the northern half of the property (see Figure 2-9, and also Plate 1 in Volume 2). The distinctive ridge and swale topography in the eastern undeveloped part of the property reflect original beach ridges and swales created by former Lake Michigan shoreline processes.

Runoff from the developed area of the plant is to the north, east, and south (to the East Branch). Rainfall within the center of the developed portion of the site infiltrates the soil or evaporates. Runoff from the ridges in the nature area collects in adjacent low-lying swales. Runoff from the southern part of natural area flows to the East Branch. Standing water is present along the edges of the property and within the natural area. The normal stage in the East Branch adjacent to the site is roughly 582 feet above mean sea level (Greeman 1995).

According to the National Wetlands Inventory (NWI) Map, wetlands are present on and near the site, with most of the onsite wetlands within the natural area (Figure 2-10). The land surface elevations in these areas are less than or equal to 585 feet. (Because a jurisdictional wetlands survey has not been conducted on the DuPont property, the extent to which the NWI areas constitute true wetlands has yet to be determined).

Site Vegetation and Surface Cover

Historically, there has been limited (if any) vegetative cover or habitat within the developed part of the facility. A significant part of the land surface within the manufacturing area was compacted and paved during site development. Though all the aboveground facilities in the previously active manufacturing area (see Figure 2-3) have been removed, foundations, building rubble, and pavement can be seen on the land surface in many of the former operating areas.

Few materials have been placed on the ground within the waste management areas to the north since the late 1970s with two exceptions. One was the filling of low-lying areas during facility demolition in the mid- to late 1980s (Meyer 1997). The other exception is the placement of wastewater treatment filter cake in the active landfill. Vegetation is re-establishing itself over most of the inactive waste management areas.

Within the eastern undeveloped portion of the site, a remnant ridge and swale (also referred to as dune and swale) community is present. This community is actually a complex mosaic of numerous small patches of distinct habitats or botanical community types so closely interspersed that they cannot be individually mapped. These community types include wet and dry sand prairie, sand savanna, sedge meadow, marsh, swamp shrub, and pond (TAMS 1991; COE 1997). Also present in the undeveloped area is a stand of cottonwood trees that have sprung up on the fill placed there during I-90 construction.

Physiography and Geology

Regional Physiography and Geology

The site lies within the Calumet Lacustrine Plain physiographic province, which extends southward from Lake Michigan's shoreline to the Valparaiso Moraine (Figure 2-11). The surficial geologic deposits are dune and beach complex deposits formed during and after the last glacial age, when Lake Michigan water levels were significantly higher than present levels. Beach ridges and dunes are characterized by fine to medium sands that are intermittently coarse or pebbly and rich in natural organic matter. This unit, known as the Calumet Sand, is up to 65 feet thick (Watson et al. 1989). The sand unit thins to 0 feet to the west of the Illinois-Indiana border to the southwest in the valley of the Little Calumet River.

The Calumet Sand was deposited on an irregular surface eroded into glacial till and/or lacustrine clay. The till consists of a stiff gray silty clay matrix with pebbles and rock fragments. There are discontinuous sand and gravel layers within the till. The Calumet sand/till contact slopes toward Lake Michigan at approximately 0.0013 ft/ft. Together, the thickness of the till and Calumet Sand is roughly 100 to 160 feet. The till lies directly upon the bedrock near the plant site (Figure 2-12 and 2-13).

Beneath the Calumet Sand and the till lies a sequence of about 4,400 feet of sedimentary rocks (Rosenshein and Hunn 1968). They are, from youngest to oldest, a Middle Silurian Dolomite, an Upper Ordovician Shale, a Middle Ordovician Sandstone, a Lower Ordovician and Upper Cambrian Dolomite and Sandstone, and an Upper Cambrian Sandstone, Shale, and Dolomite. The relationships and thicknesses of the geologic strata in the region are illustrated in Figure 2-14.

Site Soils, Geology, and Stratigraphy

Four soil types are present at the DuPont facility (USDA 1972):

- Carlisle Muck—deep, poorly-drained organic soils with 4 to 6 feet of peat over sand, marl, or silt, and a high water table
- Tawas Muck—deep, poorly-drained soils with 1 to 3.5 feet of peat over sand and a high water table
- Oakville-Tawas Complex—long, narrow ridges and sloughs in alternating strips 60 to 100 feet wide, and ridges of Oakville fine sand and sloughs of Tawas muck (peat)

- Urban Land—areas filled with earth, cinders, basic slag, trash, or any combination of these, and that then have been smoothed over to the extent that the original soil type cannot be identified

The Carlisle muck soils (peats) are low-lying lands adjacent to the river. Tawas muck soils (peats) are found in the southwest corner and northern third of property. Oakville-Tawas complex soils are in the undeveloped area of the site that covers the eastern part of the property. This complex also includes peats.

Soils in the developed area have been largely regraded and covered with fill, and are now classified as urban land. It is likely that Oakville-Tawas soils were present at the land surface before the site was developed (Shilts, Graves and Associates 1978). Urban land is also present on the eastern part of the property where fill materials were deposited during the construction of I-90.

Site unconsolidated subsurface deposits are uniform beach sand (the Calumet Sand) overlying clay till. During site investigations, the base of the sand (the sand/till contact) was encountered at depths of 27 to 42 feet below grade. During Phase II, cross sections were prepared for the site. Geologic cross section locations are shown in Figure 2-15a, and sample sections are shown in Figures 2-15b and 2-15c. The Phase III lithologic information (see stratigraphic logs in Volume 2) clearly established the uniformity of the sand in the Calumet Sand deposits at the site.

Site bedrock stratigraphy is documented in the log for a deep test well installed (and later abandoned) in 1915 by the Grasselli Corporation. Site-specific stratigraphy is consistent with regionally-reported stratigraphy, with the Calumet Sand present to a depth of 40 feet below ground (directly underlain by a clay till) and Silurian dolomite bedrock encountered at 150 feet below ground. Ordovician and Cambrian dolomite and sandstone units are logged to a depth greater than 1,800 feet below ground underlying the Silurian dolomite unit (Table 2-3).

Hydrogeology

Regional Hydrogeologic Setting

Calumet Sand Aquifer Flow System

Where saturated, the Calumet Sand is known as the Calumet Aquifer (formerly referred to as the Calumet Sand Aquifer). Over the past 35 years, the U.S.G.S. and others have extensively investigated the geologic, hydrogeologic, potentiometric, and, more recently, water quality conditions of the aquifer (Rosenshein 1961; Rosenshein and Hunn 1968; Hartke et al. 1975; Watson et al. 1989; Fenelon and Watson 1993; Greeman 1995; Kay et al. 1996). The aquifer represents the uppermost, unconfined groundwater system in the area.

Regionally, the saturated thickness of the Calumet Aquifer ranges from 0 to 70 feet, porosity from 0.3 to 0.4, transmissivity from 670 to 4,000 ft^2/day, and hydraulic conductivity from 1 to 180 ft/day (Rosenshein 1961; Rosenshein and Hunn 1968; Hartke et al. 1975; Watson et al. 1989; Fenelon and Watson 1993; Greeman 1995; Kay et al. 1996). The primary inflow to the Calumet Aquifer is recharge by precipitation infiltration. Annual recharge from precipitation has been estimated at 5 to 13 inches/year (Watson et al. 1989; Fenelon and Watson 1993; Greeman 1995).

The hydraulic conductivity of the clay till underlying the Calumet Aquifer is estimated to range from 0.0004 to 0.06 ft/day; Rosenshein 1961; Fenelon and Watson 1993; Kay et al. 1996). Under the vertical gradients observed in the region, the till acts as a confining unit separating the Calumet Aquifer from the uppermost bedrock aquifer below.

Over the past 12 years, the U.S.G.S. has measured water levels at a network of 96 groundwater and surface water sites in Northern Lake County in northwest Indiana (Greeman 1995). Five of the wells installed and monitored by the U.S.G.S. as part of the regional studies are located on the DuPont property. These observation wells are C-5, C-10, C-12, C-15, and D-66. In addition, one U.S.G.S. surface water monitoring station (C-16S) is present near the C series wells. (A map showing the locations of the monitoring stations and some of the data collected by U.S.G.S. are provided in Volume 2.) Potentiometric surface maps have been developed using U.S.G.S. potentiometric data (example provided in Figure 2-16; U.S.G.S. 1989). The data indicate that groundwater flow discharges to area surface water bodies (Lake Michigan, Grand Calumet System) or is captured by area sewers, drains, or other dewatering systems.

Deeper Groundwater Flow Systems

There are two major bedrock groundwater systems in northwest Indiana (Hartke et al. 1975). The shallow bedrock system, at roughly 150 feet below ground, consists of jointed and fractured Devonian and Silurian limestone and dolomite that may have karst features. Typically only the upper 50 feet of the bedrock system has been used for groundwater production, but wells may extend to depths of 300 feet. The deep bedrock system is made up of three major sandstone units at depths greater than 1,400 feet below ground. The deep bedrock system is rarely used for groundwater production, but it has been used for waste injection, regionally.

Site-Specific Hydrogeology

Calumet Aquifer Properties

Site-specific geologic and hydrogeologic data have been collected as part of the Phase II and Phase III investigations conducted by DuPont. DuPont's onsite monitoring network consists of 22 monitoring wells and 2 staff gauges (Figure 2-17). Eighteen piezometers are also present onsite. (Their locations are not shown in Figure 2-17 because they have yet to be surveyed). The first three wells were installed by U.S. EPA in 1983. During Phase II, geologic logs for 18 borings were generated and 17 monitoring wells were installed (CH2M HILL 1991). During Phase III, geologic logs for 174 additional borings were generated, and two monitoring wells and the piezometers were installed (see Volume 2). Original and updated elevation survey and well construction data are contained in Volume 2.

Aquifer properties are summarized in Table 2-4. The Calumet Aquifer at the DuPont facility has been described as a poorly-graded, fine-grained sand (SP) (see Volume 2). Phase II and III soil logs indicate the Calumet Sand ranges from 27 to 42 feet in thickness at the site, with an average saturated thickness of about 25 to 30 feet. The elevation of the base of the sand is illustrated in Figure 2-18. An average horizontal hydraulic conductivity of 6.3×10^{-3} cm/s

(18 ft/day) has been calculated for the Calumet Aquifer at DuPont, based on the results of testing at nine locations across the facility, conducted during either Phase II or III.

Depth to Groundwater and Potentiometric Conditions

Groundwater typically has been encountered at depths ranging from zero to 10 feet below ground at the site. During Phases II and III, more than a dozen rounds of groundwater elevation measurements were collected. Typical potentiometric surfaces generated using these data are presented in Figure 2-19 for Phase II and Figure 2-20 for Phase III. Phase III data indicate that mounding may occur near the active landfill and rubble area (Figure 2-20). Based on a comparison to regional data collected by the U.S.G.S. (see Figure 2-16), groundwater flow at the site in the Calumet Aquifer is generally consistent with regional conditions.

Groundwater gradients are steepest toward the East Branch, ranging from 0.004 to 0.01 ft/ft based on data collected during Phase II. Groundwater gradients to the north, towards Riley Park, range from 0.007 to 0.008 ft/ft based on Phase II data.

Groundwater and Surface Water Interaction and Groundwater Flow Directions

Groundwater elevation data collected during Phases II and III show an east-west groundwater divide running through roughly the center of the site (Figure 2-21). Groundwater flow directions are south (south of the divide) toward the East Branch, and north (north of the divide) toward the Riley Park community, the salvage yard, and the petroleum facility.

Groundwater and surface water elevation data indicate the groundwater and surface water are hydraulically connected. Standing water observed at the site may be due to surface expressions of groundwater, or slow infiltration of surface water due to the local presence of fine-grained sediments. When waterway levels are low compared to site groundwater levels, springs have been observed at the channel's edge.

DuPont data show that groundwater flowing to the south consistently discharges to the East Branch. However, a comparison of water elevations in the surface water monitoring station adjacent to the site, U.S.G.S. station C-16S, and U.S.G.S. monitoring well C-15, the closest well to the waterway, indicates that groundwater elevations in well C-15 can frequently be below the waterway elevation (Figure 2-22). This finding suggests that, at least in some locations and within a limited distance from the channel bank, localized or periodic reversals in discharge/recharge relationships between groundwater and surface water may occur. As a result, groundwater monitoring points immediately adjacent to the channel may not be completely representative of groundwater discharging to the waterway, because they may be influenced by periodic reversals of flow and discharge from the waterway to the groundwater.

Groundwater Discharge to the East Branch

Water balance estimates performed using the U.S.G.S. estimates of recharge (5 to 13 in./yr) across areas on both sides of the groundwater divide were consistent with groundwater discharge estimates calculated using observed hydraulic conductivities and potentiometric surface gradients. Based on the hydraulic conductivities and gradients measured during Phases II and III, groundwater discharge to the south (towards the East Branch) was estimated at about 100 gallons per minute (DuPont file information and CH2M HILL 1991).

Groundwater Flow North of the Plant

Groundwater at the site north of the divide was found to flow towards Riley Park. A potentiometric surface map for the Calumet Aquifer was developed from a single round of water level measurements made in the sewer manholes in Riley Park (Figure 2-23). Based on that data set, an east-west groundwater divide exists in the center of this area. Groundwater is being captured by sewers and basement sumps. The sumps typically discharge to the ground surface, where the water flows into ditches or sewers.

Regional Water Supply

Water Supply

Lake Michigan is the source of domestic water supply for the City of East Chicago and surrounding communities (Hammond, Whiting, Gary). Shallow groundwater from the Calumet Aquifer is not used as a potable water supply. The bedrock aquifer, about 150 feet below ground, is used in a limited capacity for nondrinking industrial water.

Area Groundwater Use and Area Wells

Two surveys have been conducted to identify wells near the DuPont facility, one in the late 1980s (CH2M HILL 1990) and the other as part of this current conditions assessment. (see Volume 2). Most of the wells on or within 1 mile of the facility currently on record with the Indiana Department of Natural Resources (IDNR) are U.S.G.S. and DuPont wells; others are monitoring or compliance wells. Forty-five wells were identified in the most recent survey. Eight of the wells are located at a depth of 45 feet or less below ground surface, and are therefore considered to be located within the shallow Calumet Aquifer. Exact well location and construction information is not available for many of the wells in the list provided by IDNR (see Volume 2).

Five deep injection wells (completed in bedrock at depths greater than 2,000 feet below ground) are used for waste disposal purposes in northwest Indiana (Hartke et al. 1975). These wells are more than 1 mile from the facility.

TABLE 2-1
Example "Sites" under Investigation, Remediation, or Hazardous Waste Regulation within the Region

Company Name	Location	Type of Site	Under Investigation or Remediation*
American Recovery Co., Inc.	East Chicago, IN	RCRA TSD Facility	
Amoco Pipe Line	Hammond, IN	RCRA Large Quantity Generator	
Amoco Whiting Refinery	Whiting, IN	Memorandum of Cooperation Site	X
Anderson Development Co.	Gary, IN	CERCLIS Site	
Ashland Chemical	Hammond, IN	CERCLIS Site	
Bairston W. Company	Hammond, IN	CERCLIS Site	
Black Beauty Products Site	Gary, IN	CERCLIS Site	
Black Oak Landfill	Gary, IN	CERCLIS Site	
Bongi Cartage	Gary, IN	CERCLIS Site	
Calumet Containers	Hammond, IN	CERCLIS Site	
Calumet College AKA Amoco Research Facility	Hammond, IN	CERCLIS Site	
Chemical Haulers	Hammond, IN	CERCLIS Site	
Citco Petroleum Company	East Chicago, IN	RCRA TSD Facility	
Cities Service Company East Chicago Refinery	East Chicago, IN	CERCLIS Site	
Conservation Chemical Company	Gary, IN	Hazardous Waste Landfill	X
East Chicago Dump	East Chicago, IN	CERCLIS Site	
Energy Cooperative Inc.	East Chicago, IN	CERCLIS Site	X
Federated Metals Corporation Whiting	Hammond, IN	Hazardous Waste Landfill	
Gary City Landfill	Gary, IN	CERCLIS Site	
Gary Developing Company, Inc.	Gary, IN	Hazardous Waste Landfill	
General American Transport Corporation	East Chicago, IN	Hazardous Waste Landfill	
General American Transport Corporation	East Chicago, IN	Hazardous Waste Landfill	
Hammond Valve Corporation	Hammond, IN	RCRA TSD Facility	
Hammond Sludge Lagoon	Hammond, IN	CERCLIS Site	
House's Junk Yard	Hammond, IN	CERCLIS Site	
Indiana Harbor WWS	East Chicago, IN	RCRA TSD Facility	
Industrial Cinder, Inc. Site #77	Gary, IN	CERCLIS Site	
Industrial Disposal Corporation	East Chicago, IN	CERCLIS Site	
Inland Steel Company	East Chicago, IN	RCRA Corrective Action Site	X
KA Steel Chemicals, Inc.	Gary, IN	RCRA TSD Facility	
Lehigh Portland Chemical Co.	Gary, IN	RCRA TSD Facility	
Lake Sandy Jo/M & M Landfill	Gary, IN	Superfund Site	X
LaSalle Steel	Hammond, IN	RCRA TSD Facility	
LTV Steel Company Inc.	Hammond, IN	CERCLIS Site	
Luria Brothers	Gary, IN	Hazardous Waste Landfill	
M & T Chemical Inc.	East Chicago, IN	CERCLIS Site	
Mercier	Gary, IN	Hazardous Waste Landfill	
Mid Continental Coke Company	Gary, IN	CERCLIS Site	
Midco Site I	Gary, IN	Superfund Site	X
Midco Site II	Gary, IN	Superfund Site	X
Mobil Oil Corporation	Gary, IN	Memorandum of Cooperation Site	X
Ninth Avenue Dump/Red Top	Gary, IN	Superfund Site	X
NIPSCO	East Chicago, IN	Memorandum of Cooperation Site	X
Hammond Dump	Hammond, IN	CERCLIS Site	
Phillips Pipe Line Company	East Chicago, IN	Memorandum of Cooperation Site	X
Pollution Control of Indiana	East Chicago, IN	RCRA TSD Facility	
Purex Corporation	East Chicago, IN	CERCLIS Site	
R & R Industrial Park	Hammond, IN	CERCLIS Site	
Rhone Poulenc	Hammond, IN	RCRA TSD Facility	X
Roland Dump	Gary, IN	Superfund Site	X
Safety Kleen	East Chicago, IN	Memorandum of Cooperation Site	
Sheffield Scrap	Hammond, IN	CERCLIS Site	
Shell Oil Company Terminal	Hammond, IN	CERCLIS Site	
Site #75	Gary, IN	CERCLIS Site	
Standard Alloys Corporation	Hammond, IN	CERCLIS Site	
Tyler Street Dump Site	Gary, IN	CERCLIS Site	
Union Carbide Corporation East Chicago	East Chicago, IN	CERCLIS Site	
U.S.S. Lead Inc.	East Chicago, IN	RCRA Corrective Action Site	X
U.S. Steel Gary Works	Gary, IN	RCRA Corrective Action Site	X
Viking Engineering	Hammond, IN	TCRA Small Quantity Generator	
Vista Chemical Company	Hammond, IN	TCRA Small Quantity Generator	
Vulcan Materials Company	Gary, IN	CERCLIS Site	
Western Scrap Corporation	Gary, IN	CERCLIS Site	

Sources:
1. The Remedial Action Plan for the Indiana Harbor Canal, the Grand Calumet River, and the Nearshore Lake Michigan, Stage I, IDEM, 1991.
2. EDR Database Search (1997).
3. Memorandum of Cooperation between U.S. EPA, IDEM, and the Underground Private Parties (AMOCO Whiting Refinery, NIPSCO, PPL, Safety Kleen, and Mobil Oil Corporation).

*Being investigated or remediated under federal or state regulatory programs or voluntary programs.

TABLE 2-2
Effluent Dischargers to the East Branch of the Grand Calumet System

Discharger Name	IDEM Outfall Identifier	Flow (mgd)
U.S. Steel Gary Works	USS NCCW	10.4330
U.S. Steel Gary Works	USS CPE	1.4110
U.S. Steel Gary Works	SWLF	0.1940
U.S. Steel Gary Works	PDF	6.1000
U.S. Steel Gary Works	RC001	0.0131
U.S. Steel Gary Works	GW001	0.1000
U.S. Steel Gary Works	GW003	0.2000
U.S. Steel Gary Works	GW004	0.3000
U.S. Steel Gary Works	GW005	41.4375
U.S. Steel Gary Works	GW010	1.3667
U.S. Steel Gary Works	GW015	2.4333
U.S. Steel Gary Works	GW017	0.0428
U.S. Steel Gary Works	GW018	46.8125
U.S. Steel Gary Works	GW019	42.5250
U.S. Steel Gary Works	GW020	51.4667
U.S. Steel Gary Works	GW021	0.6000
U.S. Steel Gary Works	GW023	0.1000
U.S. Steel Gary Works	GW026/030	29.5292
U.S. Steel Gary Works	GW032	0.3083
U.S. Steel Gary Works	GW033	0.2125
U.S. Steel Gary Works	GW034	26.2667
Gary Sewage Treatment Plant	GSTP001	60.0000
AMG Resources	AMG001	0.0680
DuPont	DP003	0.4242
Harbison-Walker Refractories	HW001	0.2120
U.S.S. Lead	USL001	0.0430

Note:
Dischargers listed from headwaters of the East Branch of the Grand Calumet System to outlet of the Indiana Harbor Canal at Lake Michigan. Dischargers on the West Branch and the Indiana Harbor Canal are not included above.

Source: Flow rates provided by C.J. Song of IDEM on September 3, 1997.

TABLE 2-3
Thicknesses and Depths of Geologic Units
Present at the DuPont East Chicago Facility

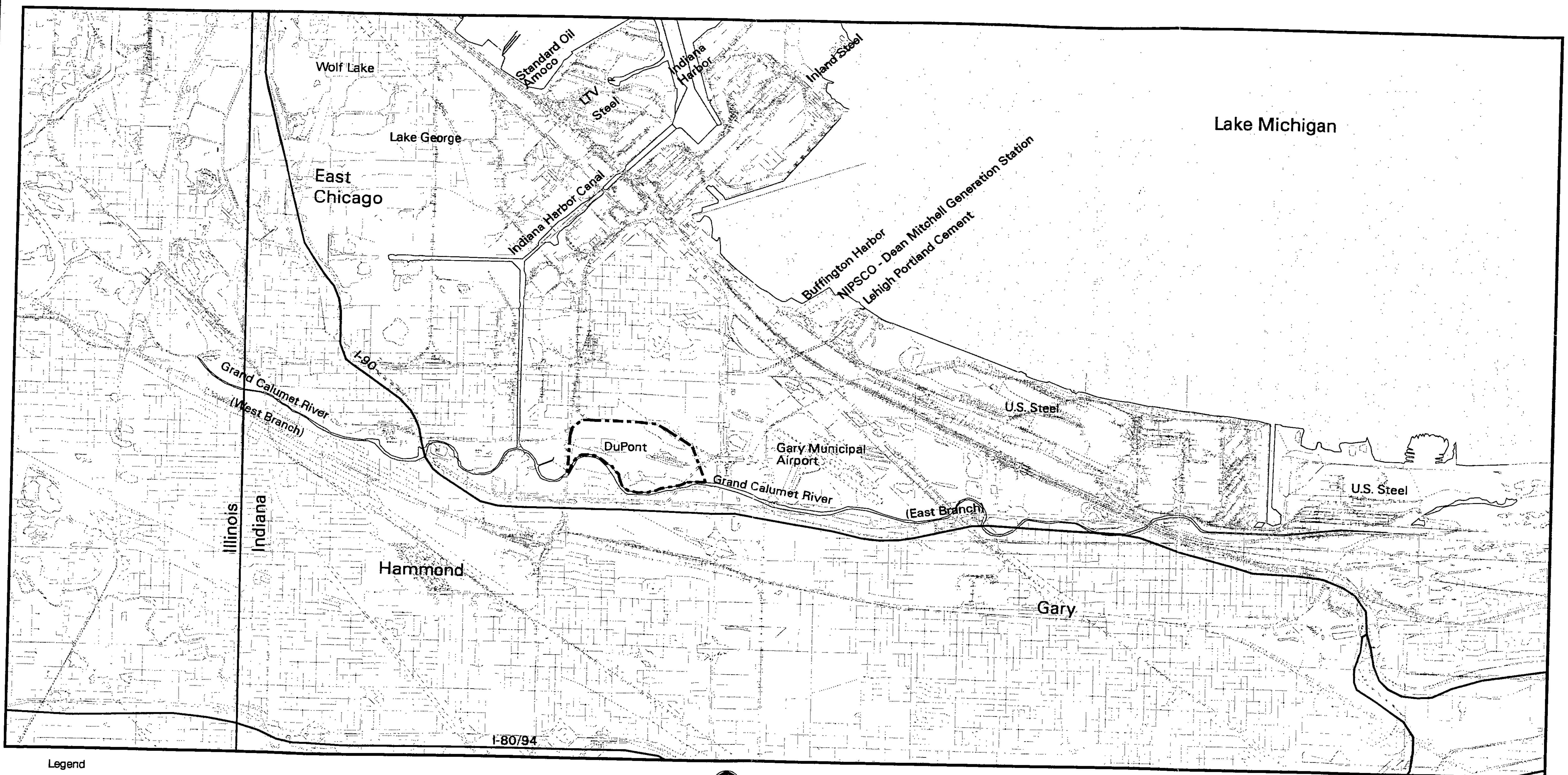
Geologic Unit	Thickness (ft)	Depth (ft)
Quaternary Age:		
Calumet Sand	40	40
Clay Till	32	72
Gravel	29	101
Clay Till	49	150
Silurian Age:		
Dolomite	490	640
Ordovician Age:		
Dolomitic Shale	135	775
Dolomite	341	1,116
Sandstone	64	1,180
Conglomerate	35	1,215
Dolomite	60	1,275
Cambrian Age:		
Sandstone	16	1,291
Dolomite	214	1,501
Sandstone	336	1,837
Dolomite	3	1,840

Note:
Based on geologic log for the deep well drilled on the DuPont property in 1915.
Source: *Phase I Groundwater Assessment* (CH2M HILL 1990).

TABLE 2-4
Aquifer Properties Summary
DuPont East Chicago Facility

Aquifer Property	Value or Range of Values Reported
Depth to Clay[a,b]	27 to 42 feet below ground
Average Depth to Clay[b]	34 feet below ground
Depth to Groundwater[a,b]	0 to 10 feet below ground
Saturated Thickness[a,b]	24 to 31 feet
Average Saturated Thickness	25[1] to 30[2] feet
Horizontal Hydraulic Conductivity[a,b]	3.6×10^{-3} to 3.1×10^{-2} cm/s (10 to 88 ft/day)
Average Horizontal Hydraulic Conductivity[a,b]	6.3×10^{-3} cm/s (18 ft/day)
Horizontal Hydraulic Gradient to the South[a]	0.004 to 0.01 ft/ft
Horizontal Hydraulic Gradient to the North[a]	0.007 to 0.008 ft/ft
Aquifer Porosity (assumed)[a,b]	0.35
Specific Yield[b]	0.05 to 0.25
Average Specific Yield[b]	0.11
Transmissivity[b]	2,884 to 19,705 gpd/ft (386 ft^2/day to 2,634 ft^2/day)
Average Transmissivity[b]	8,638 gpd/ft (1,155 ft^2/day)

Notes:
Compilation of ranges and averages for data collected during both of the DuPont Phase II and Phase III investigations.
[a]Phase II Groundwater Assessment (CH2M HILL 1991)
[b]Phase III Investigation data



Legend

DuPont Property Line

N

Scale 1:63360
1 inch = 1 mile

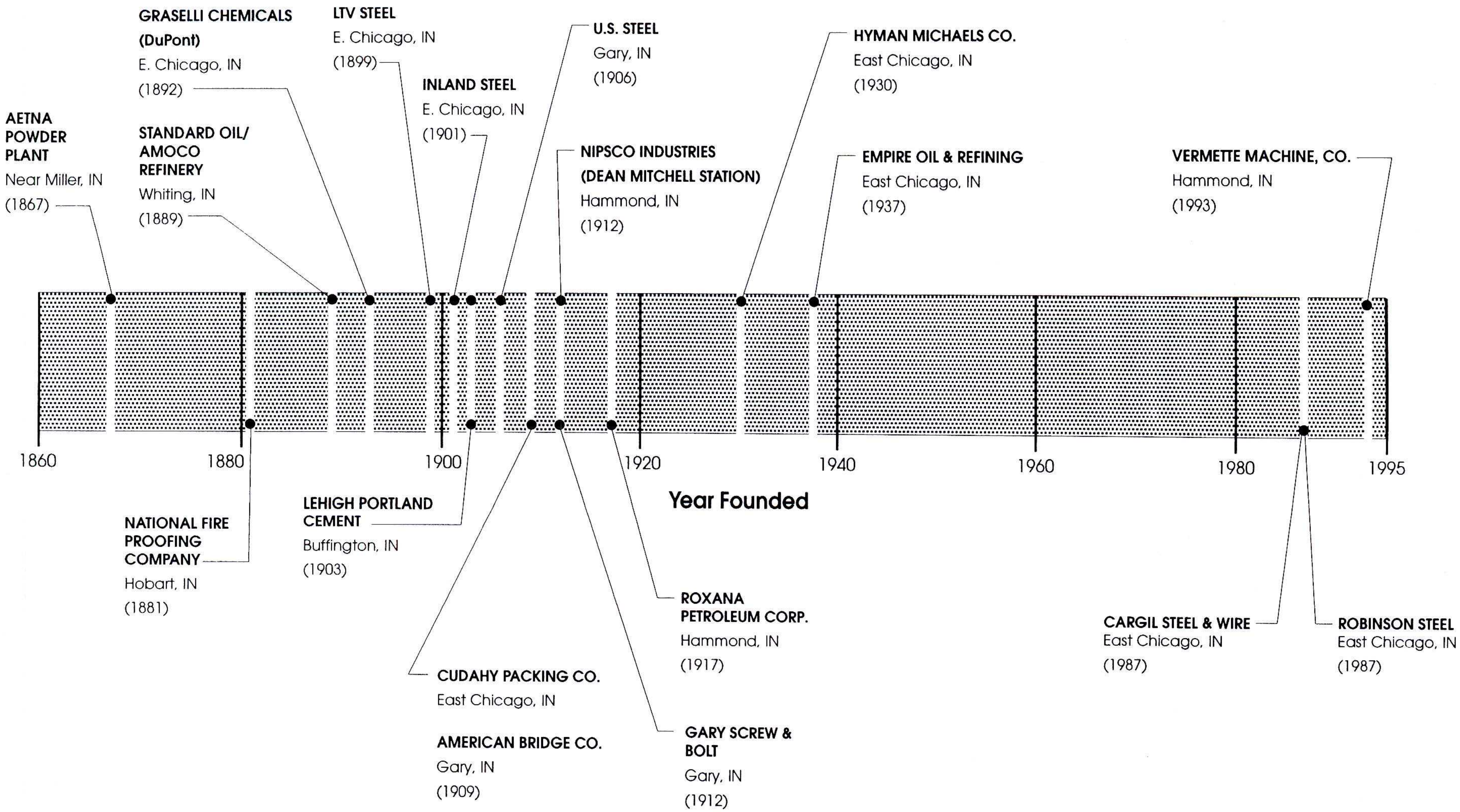
Sources:
USGS Digital Line Graphs 1:100,000;
USGS Land Use/Land Cover 1:250,000

Universal Transverse Mercator Projection,
Zone 16, 1983 North American datum.

FIGURE 2-1
The DuPont East Chicago Facility and the Northwest Indiana Region

DuPont East Chicago Current Conditions Report

CH2MHILL



Note: Date refers to approximate initial development date

Source: Moore, Powell A. 1959, Army Corp of Engineers 1997

FIGURE 2-2
Timeline of Regional Development
DuPont East Chicago Current Conditions Report

CH2MHILL

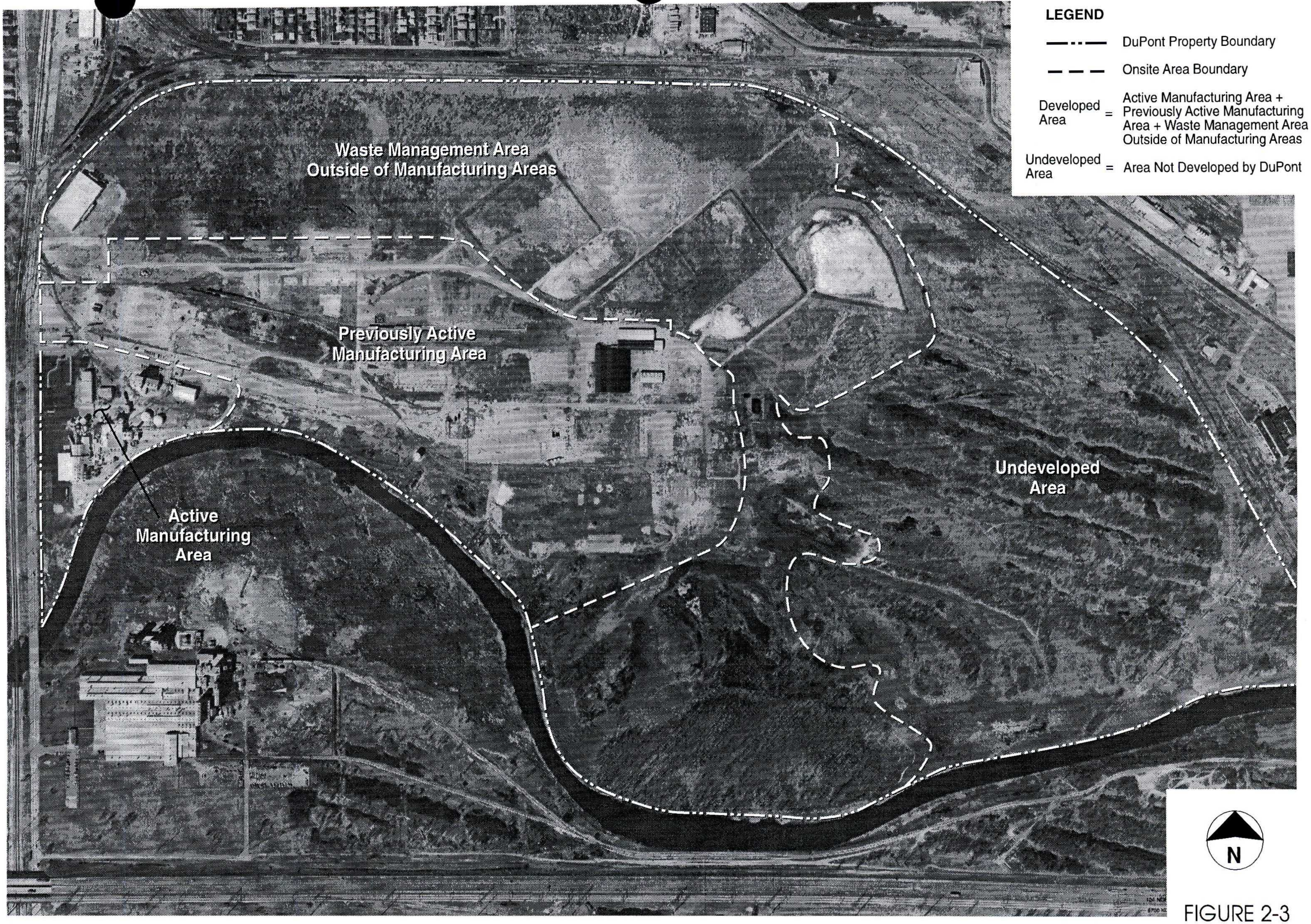


FIGURE 2-3

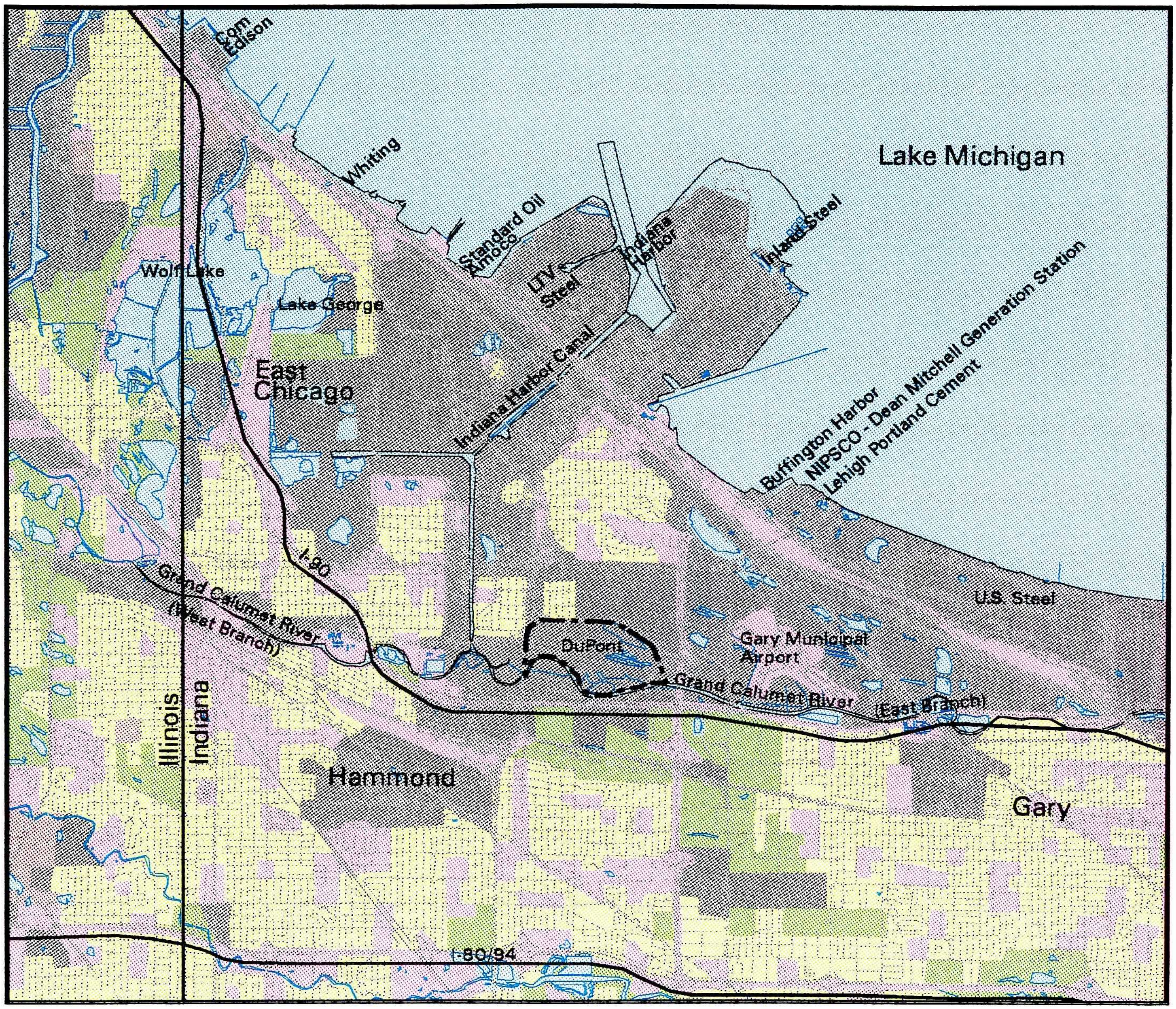
Site Areas shown on 1990 Aerial Photograph

DuPont East Chicago Current Conditions Report

Source: 1990 Aerial Photograph and Historic Facility Information in DuPont Files

CH2MHILL

E142837.EC.CC Site Aerial 10-16-97tll



Legend

- DuPont Property Line
- Residential
- Agricultural
- Urban/Commercial
- Undeveloped or Natural Area
- Industrial
- Surface Water Bodies

FIGURE 2-4
Surrounding Land Use
DuPont East Chicago Current Conditions Report

N

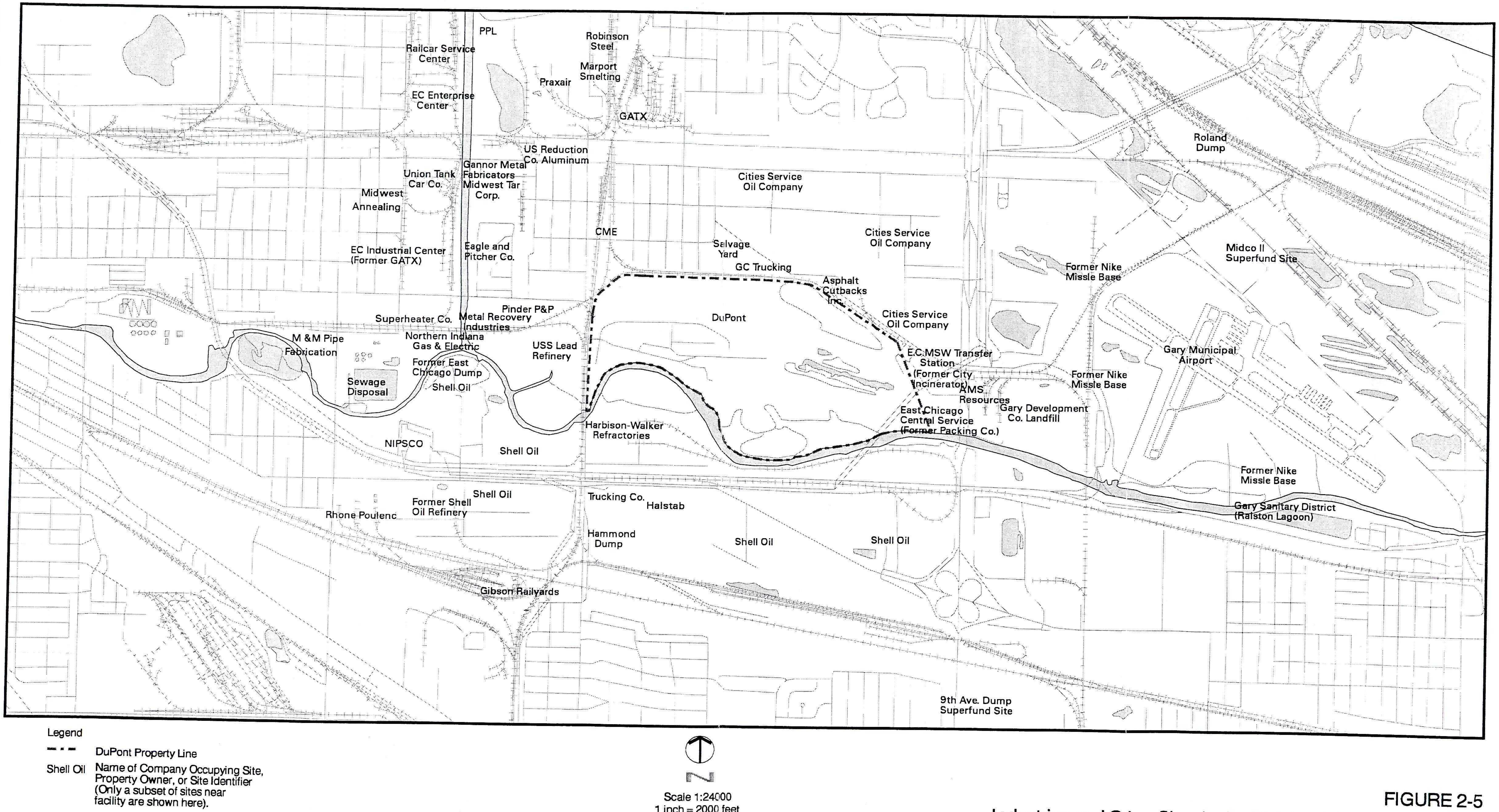
Scale 1:101376
1 inch = 1.6 mile

Sources:
USGS Digital Line Graphs 1:100,000;
USGS Land Use/Land Cover 1:250,000

Universal Transverse Mercator Projection,
Zone 16, 1983 North American datum.

CH2MHILL

October 21, 1997



Sources:
USGS Digital Line Graphs 1:100,000;
USGS Land Use/Land Cover 1:250,000

Universal Transverse Mercator Projection, Zone 16, 1983 North American datum.

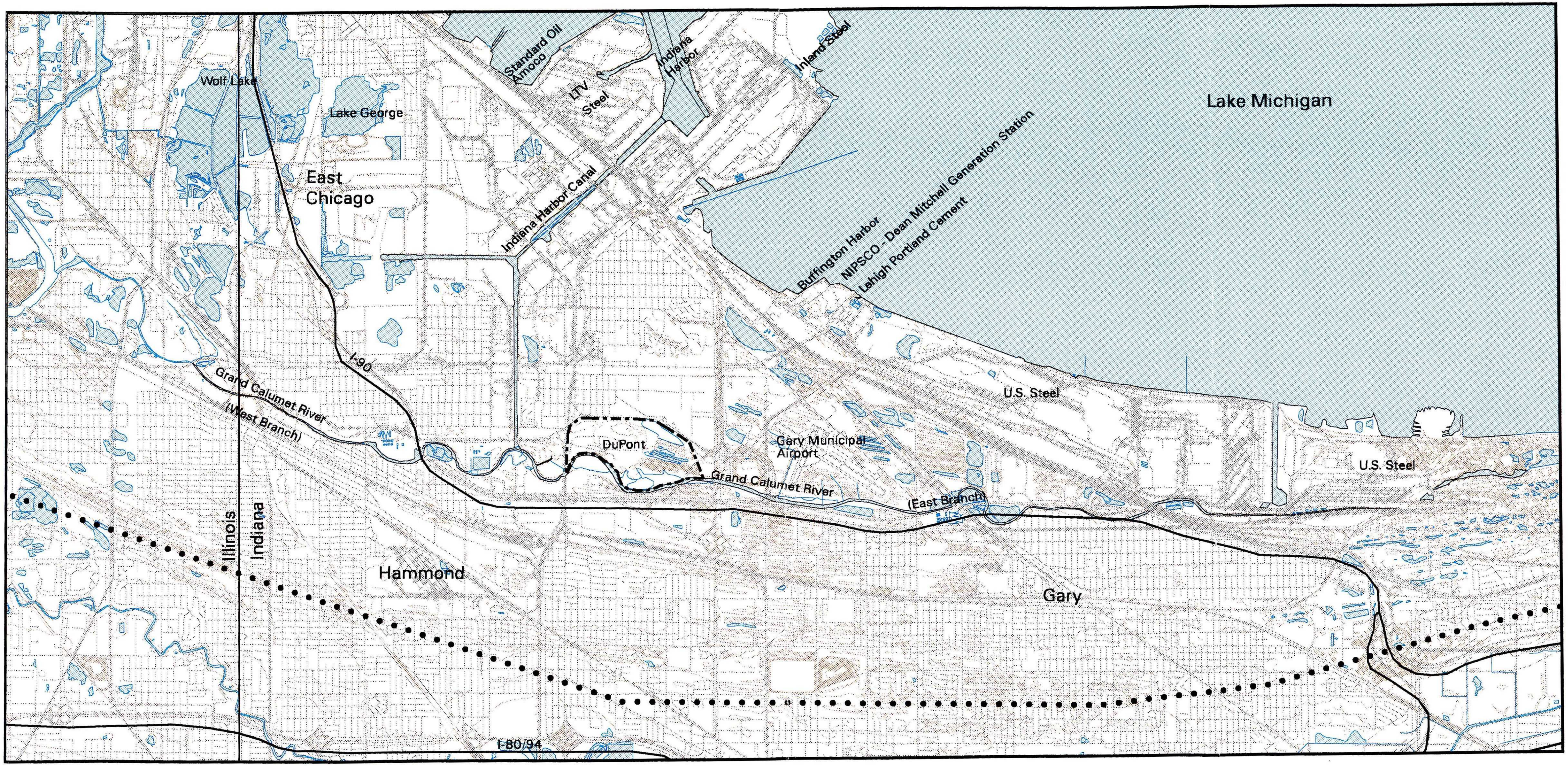
Neighborhood Windshield Survey (9/22/97), Sediment Cleanup and Restoration Project (SCRAP) II (Army Corps of Engineers June 1997), and 1973 Aerial Photograph.

FIGURE 2-5
Industries and Other Sites in the Vicinity of the DuPont Facility

DuPont East Chicago Current Conditions Report

CH2MHILL

October 22, 1997 ...25.eps



Legend
- DuPont Property Line
- Southern Grand Calumet River Watershed Boundary
- Contours

N

Scale 1:63360
1 inch = 1 mile

Sources:
USGS Digital Line Graphs 1:100,000;
USGS Land Use/Land Cover 1:250,000

Universal Transverse Mercator Projection,
Zone 16, 1983 North American datum.

FIGURE 2-6
Regional Topography and Drainage

DuPont East Chicago Current Conditions Report

CH2MHILL

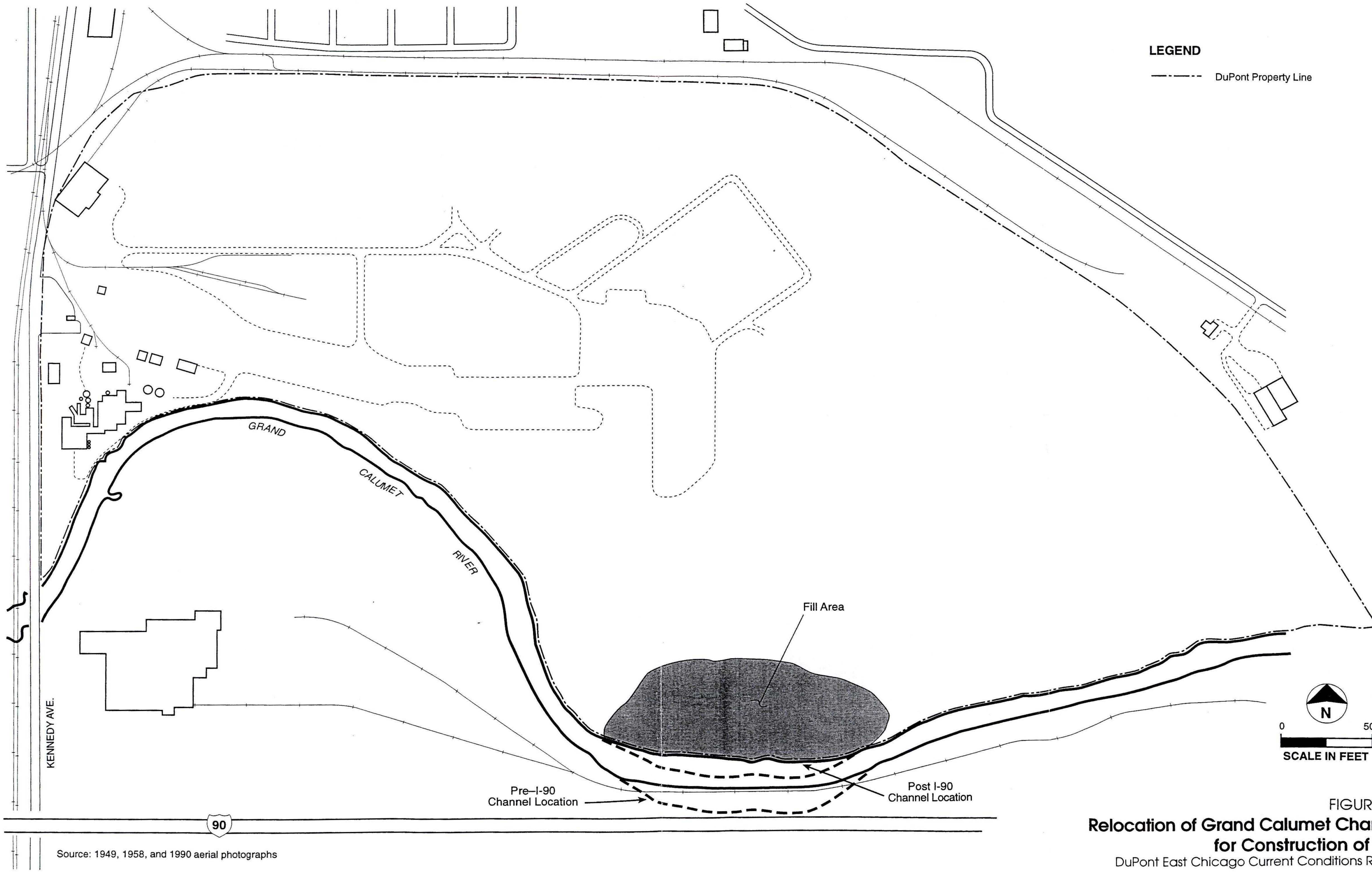


FIGURE 2-7
Relocation of Grand Calumet Channel for Construction of I-90
DuPont East Chicago Current Conditions Report
CH2MHILL

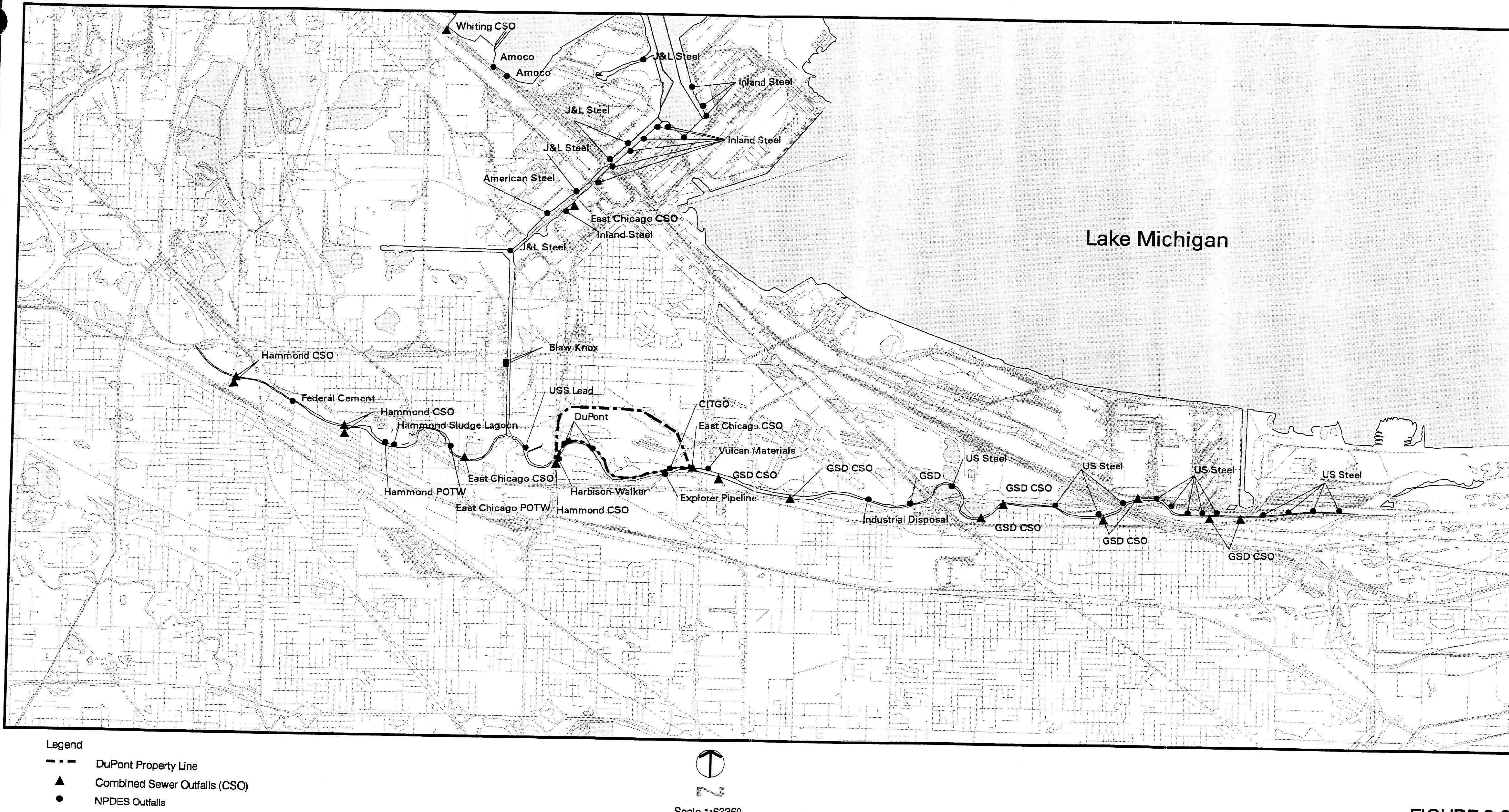


FIGURE 2-8
Effluent Discharges to the Grand Calumet System
DuPont East Chicago Current Conditions Report

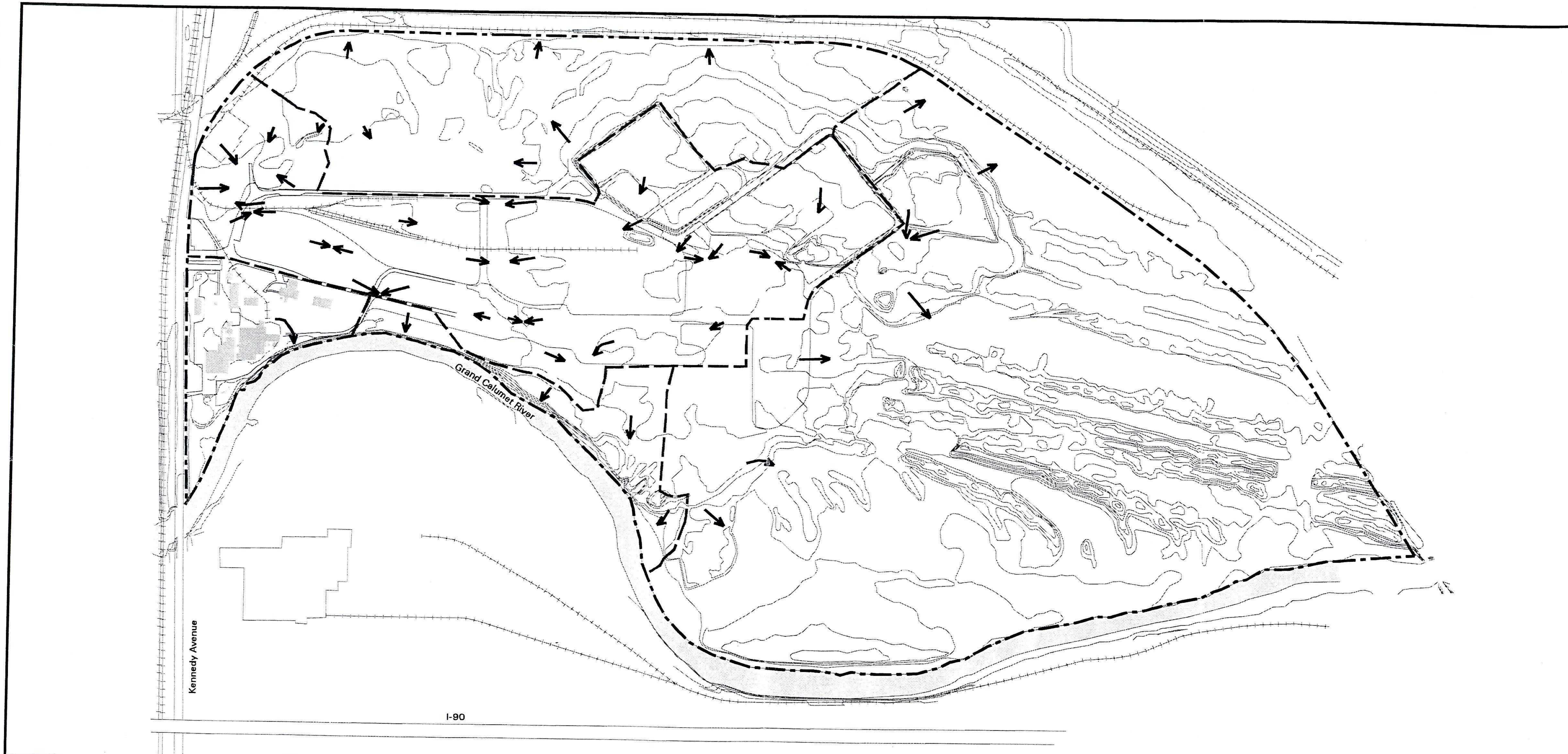
Sources:
USGS Digital Line Graphs 1:100,000;
USGS Land Use/Land Cover 1:250,000

Universal Transverse Mercator Projection, Zone 16, 1983 North American datum.

Indiana Department of Environmental Management 1986

CH2MHILL

"October 27, 1997"



Legend

DuPont Property Line

Contours - 2 ft Interval

Drainage Basin Boundary

N

Scale 1:7200
1 inch = 600 feet

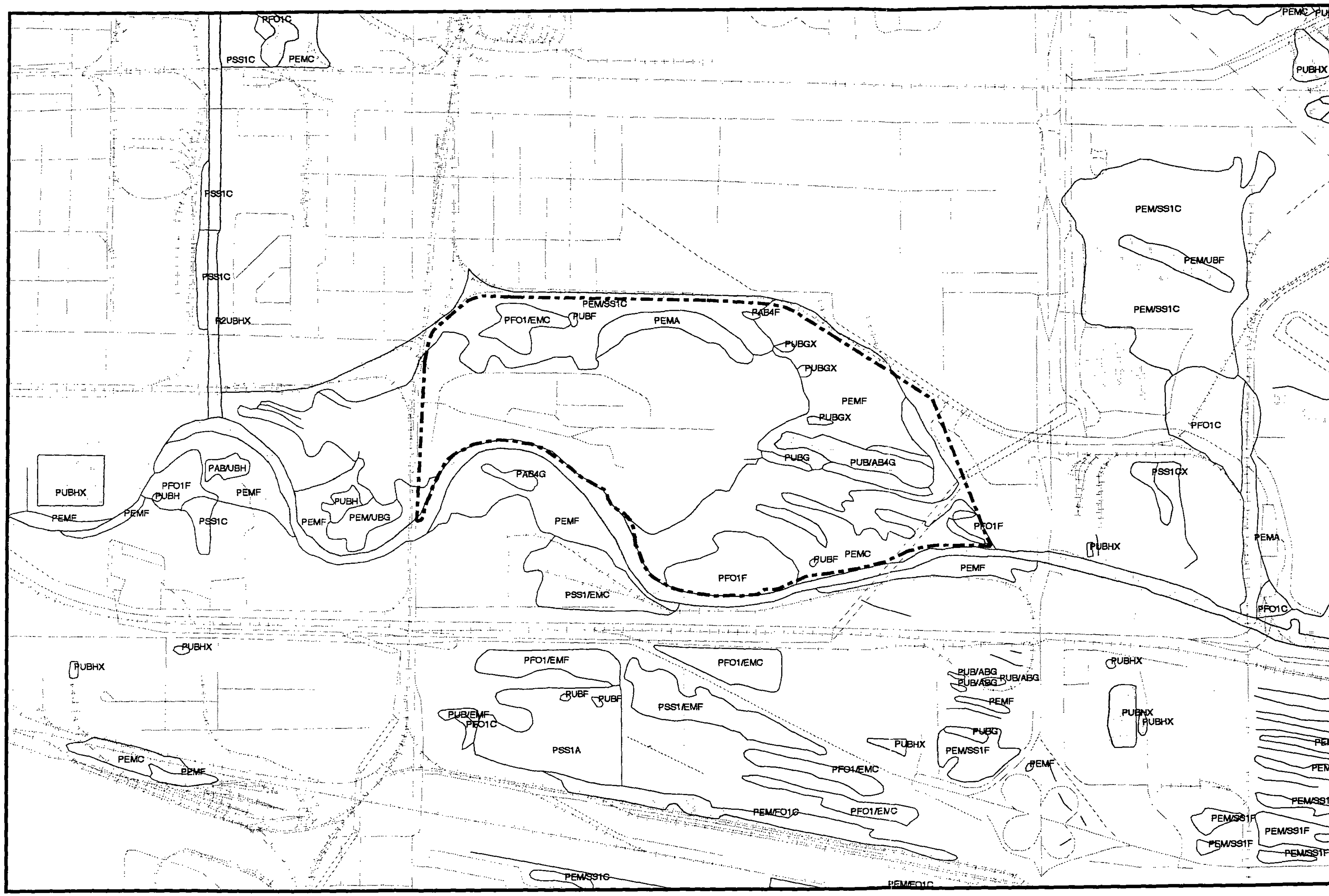
Sources:
Stormwater Permit Application (CH2M HILL 1992)

Figure 2-9
Site Topography and Drainage

DuPont East Chicago Current Conditions Report

CH2MHILL

October 21, 1997



Key to Common Codes

Palustrine
PEM Emergent marsh, wet meadow, slough, fen
PAB Pond with floating or submerged aquatic vegetation
PUS Wetland with exposed substrate
PUB Pond with open water
PSS Shrub wetland, short woody vegetation adjacent to rivers
PFO Forested wetland, tall woody vegetation adjacent to rivers

Lacustrine
L1UB Deepwater zone of lake
L2US Lake shoreline or shallow water zone of lake
L2AB Shallow lake with submerged or floating plants

Riverine
R4SB Intermittently flowing water in a stream channel
R2UB Slow moving perennial river with floodplain
R3UB Fast moving perennial river with no floodplain
R2US Bank, or sandbar of a slow moving river

Legend

- · - DuPont Property Line

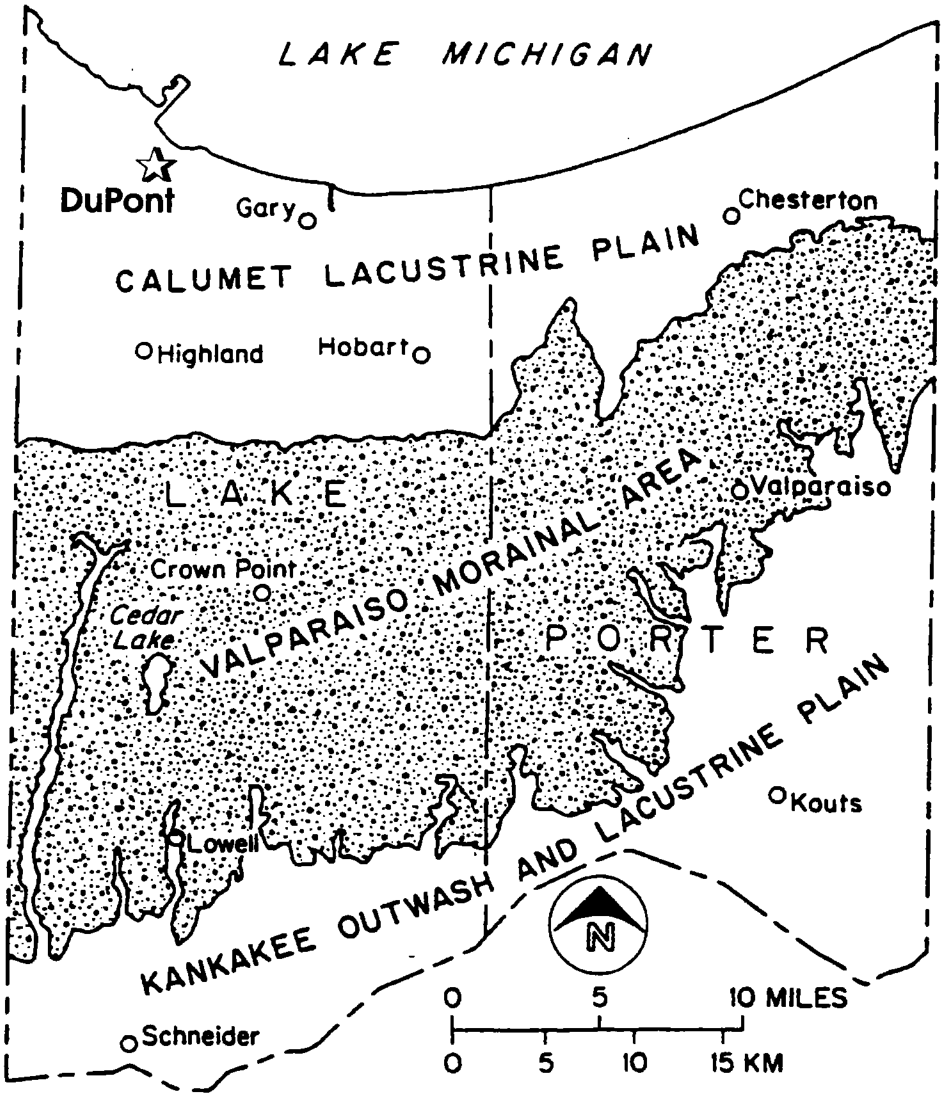
N

Scale 1:18000
1 inch = 1500 feet

FIGURE 2-10
National Wetlands Inventory in the Vicinity of the DuPont Facility
DuPont East Chicago Current Conditions Report

Sources:
USGS Digital Line Graphs 1:100,000; USGS Land Use/Land Cover 1:250,000
Universal Transverse Mercator Projection, Zone 16, 1983 North American datum.
National Wetlands Inventory, November 1981 Aerial Photography

CH2MHILL

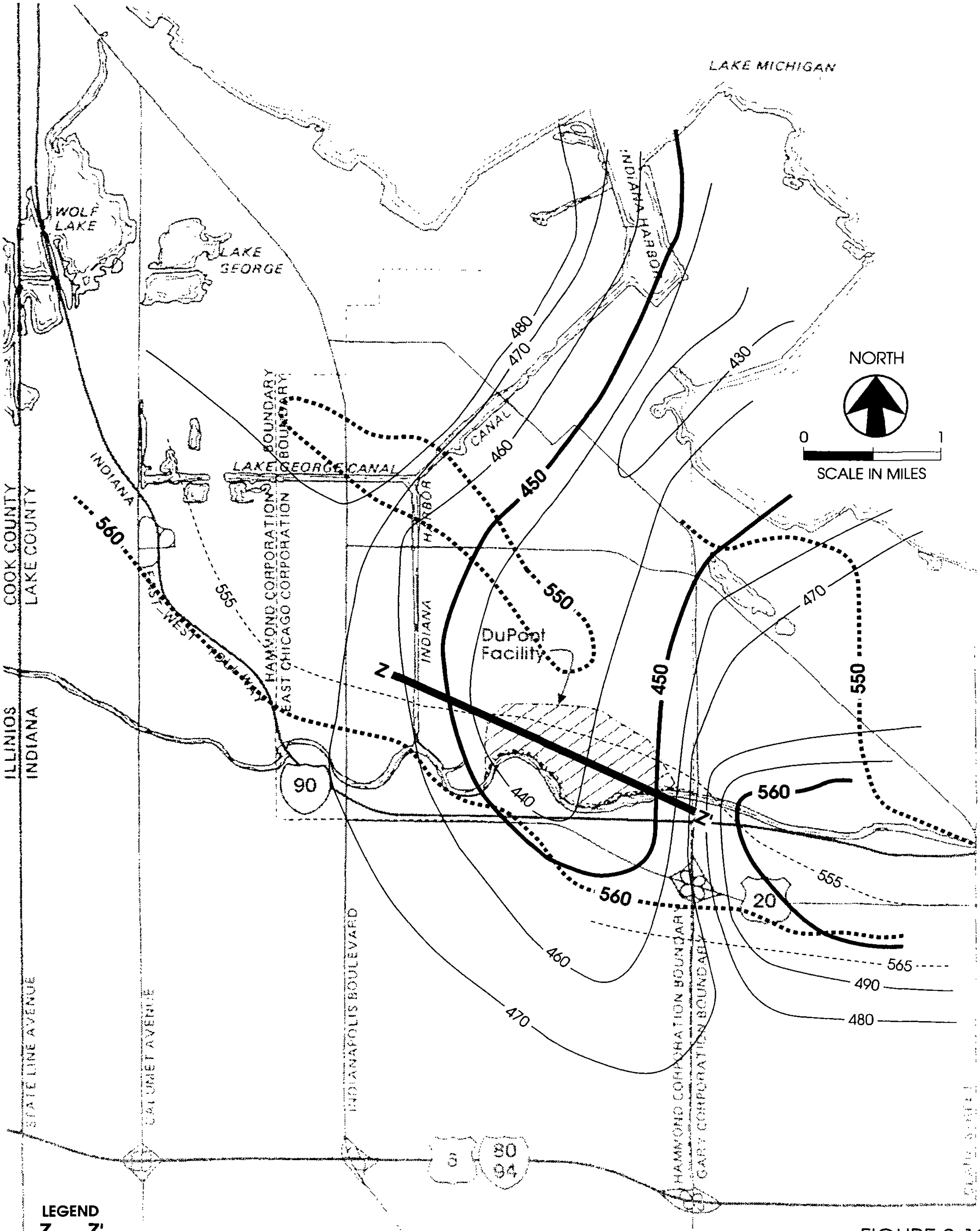


Source: Hartke et al. 1975

FIGURE 2-11
Site Location Relative to Physiographic Provinces
DuPont East Chicago Current Conditions Report

CH2MHILL

E142837.EC.CC Physiograhic Provs 10-15-97mms/tll



LEGEND

Z Z' Location of Regional Geologic Cross Section (Figure 2-13)

Elevation of the Base of the Calumet Sand (Contour Interval 5 ft)

Elevation of the Bedrock Surface (Contour interval 5 ft)

470 Elevation (ft AMSL)

Source: Watson et. al 1989

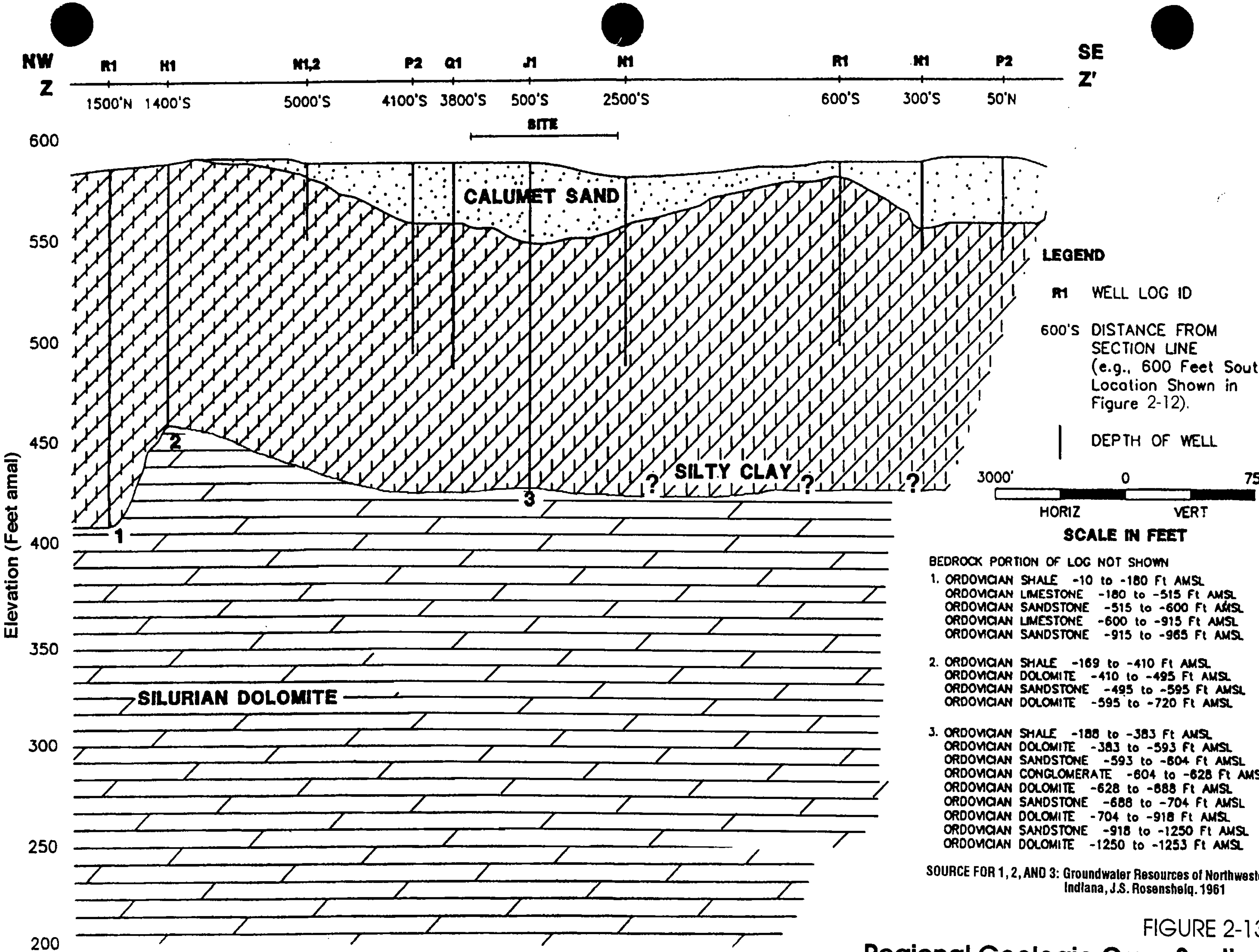
FIGURE 2-12

Top of Clay Till and Top of Bedrock Contours Within Region

DuPont East Chicago Current Conditions Report

CH2MHILL

E142837.EC.CC Top of Clay/BRK Contours 10-16-97mms/til



BEDROCK PORTION OF LOG NOT SHOWN

1. ORDOVICIAN SHALE -10 to -180 Ft AMSL
   ORDOVICIAN LIMESTONE -180 to -515 Ft AMSL
   ORDOVICIAN SANDSTONE -515 to -600 Ft AMSL
   ORDOVICIAN LIMESTONE -600 to -915 Ft AMSL
   ORDOVICIAN SANDSTONE -915 to -965 Ft AMSL

2. ORDOVICIAN SHALE -169 to -410 Ft AMSL
   ORDOVICIAN DOLOMITE -410 to -495 Ft AMSL
   ORDOVICIAN SANDSTONE -495 to -595 Ft AMSL
   ORDOVICIAN DOLOMITE -595 to -720 Ft AMSL

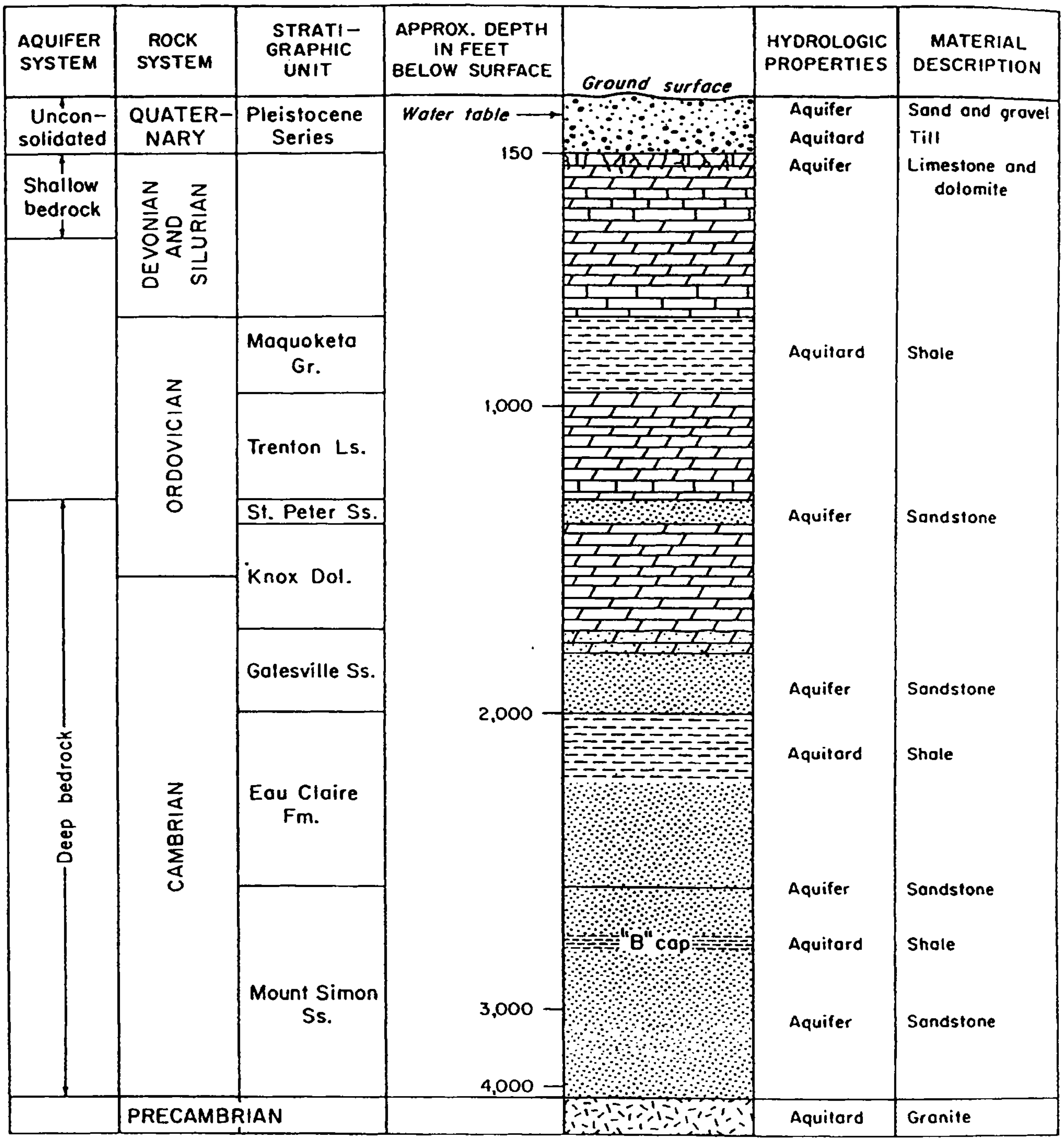
3. ORDOVICIAN SHALE -188 to -383 Ft AMSL
   ORDOVICIAN DOLOMITE -383 to -593 Ft AMSL
   ORDOVICIAN SANDSTONE -593 to -604 Ft AMSL
   ORDOVICIAN CONGLOMERATE -604 to -628 Ft AMSL
   ORDOVICIAN DOLOMITE -628 to -688 Ft AMSL
   ORDOVICIAN SANDSTONE -688 to -704 Ft AMSL
   ORDOVICIAN DOLOMITE -704 to -918 Ft AMSL
   ORDOVICIAN SANDSTONE -918 to -1250 Ft AMSL
   ORDOVICIAN DOLOMITE -1250 to -1253 Ft AMSL

SOURCE FOR 1, 2, AND 3: Groundwater Resources of Northwestern Indiana, J.S. Rosenshein, 1961

NOTE: This cross section is interpretive and was prepared by interpolating between soil boring locations. Actual subsurface conditions between borings may differ from those shown here.

Source: CH2M HILL

FIGURE 2-13
Regional Geologic Cross Section
East Chicago Plant
DuPont East Chicago Current Conditions Report



Source: Hartke et al. 1975

FIGURE 2-14

Geologic Column for Northwestern Indiana

DuPont East Chicago Current Conditions Report

CH2MHILL

E142837.EC.CC Geolog Column 10-15-97tll

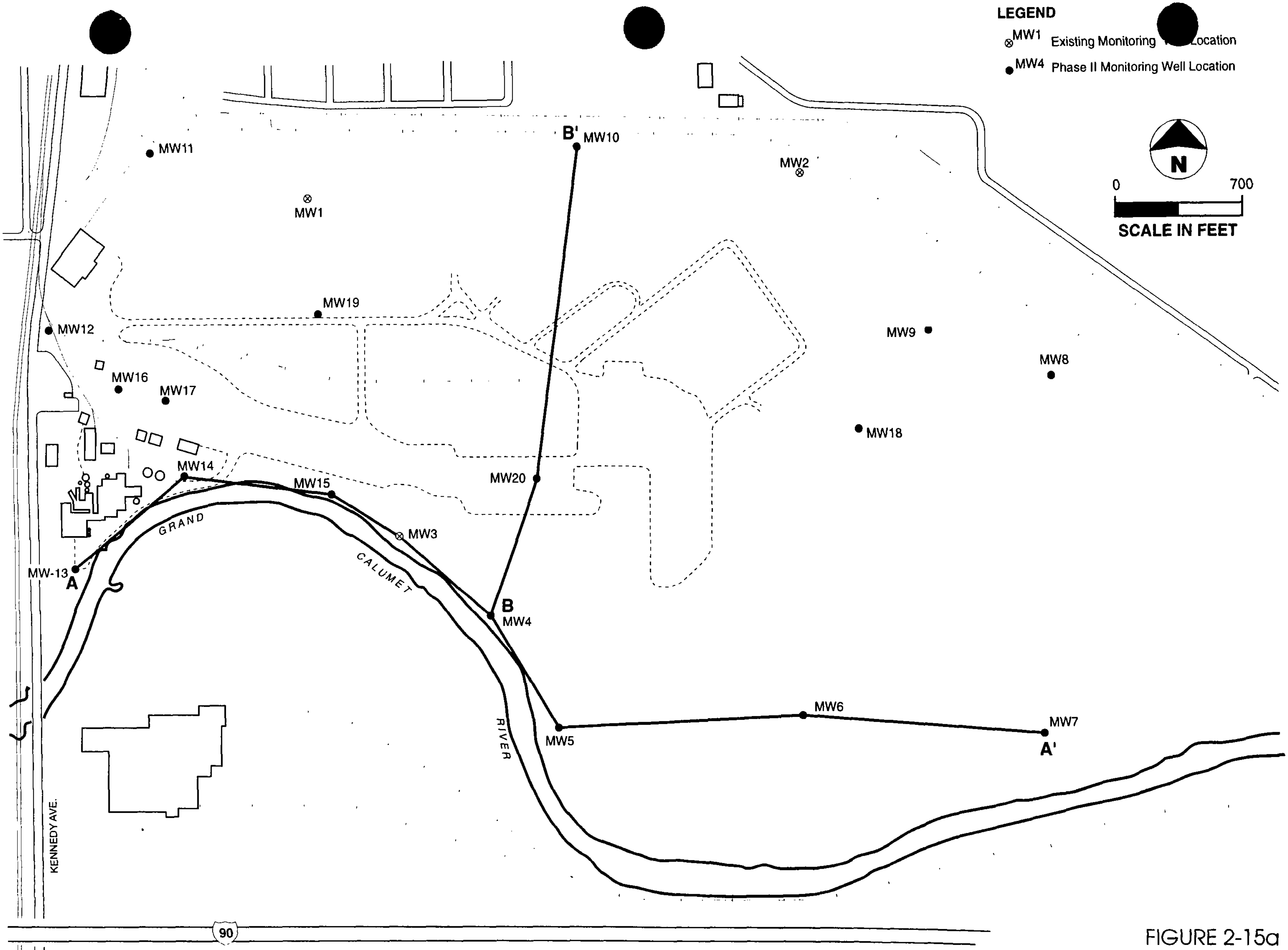


FIGURE 2-15a

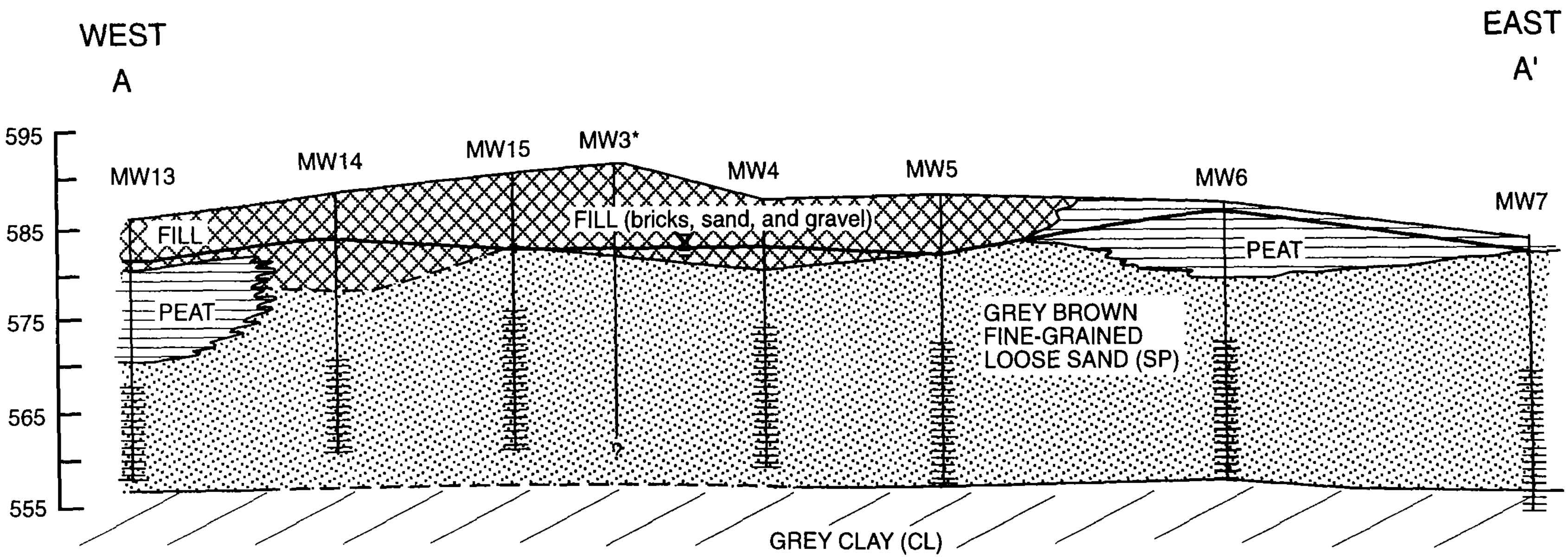
Site Cross Section Locations

DuPont East Chicago Current Conditions Report

CH2MHILL

Source: CH2M HILL 1991

E142837.EC.CC Cross Sect Locs 10-16-97mms/tll



LEGEND

* Well construction and lithologic data are not available, these are approximate depths of U.S. EPA wells.

Water elevations are measured on June 18, 1990.

Groundwater elevation

Well screened interval

MW4 Monitoring well ID

— — — Interpolated lithologic boundary

The depth and thickness of the subsurface strata indicated on the cross section were generalized from and interpolated between borings. Information on actual subsurface conditions exists only at the specific locations and dates indicated. Soil conditions and water levels at other locations may differ from conditions occurring at the boring locations. Also, the passage of time may result in a change in the conditions at these boring locations.

Source: CH2M HILL 1991

HORIZONTAL SCALE IN FEET

0 400 800

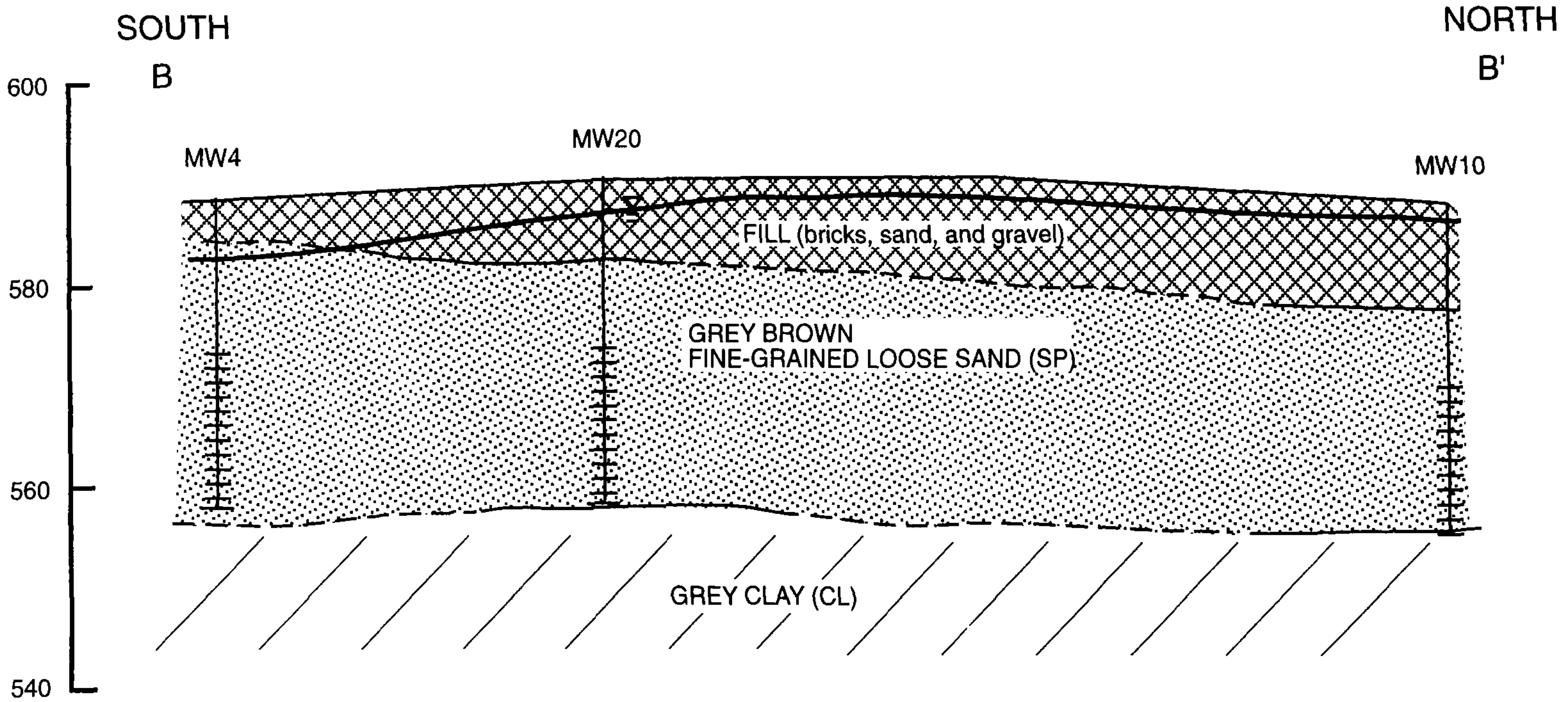
FIGURE 2-15b

Schematic Geologic Cross Section A-A'

DuPont East Chicago Current Conditions Report

CH2MHILL

E142837.EC.CC Cross Section A-A' 10-16-97mms/tll



LEGEND

Water elevations measured on June 18, 1990.

Groundwater elevation

Well screened interval

MW4 Monitoring well ID

— — — Interpolated lithologic boundary

The depth and thickness of the subsurface strata indicated on the cross section were generalized from and interpolated between borings. Information on actual subsurface conditions exists only at the specific locations and dates indicated. Soil conditions and water levels at other locations may differ from conditions occurring at the boring locations. Also, the passage of time may result in a change in the conditions at these boring locations.

HORIZONTAL SCALE IN FEET

0 200 400

Source: CH2M HILL 1991

FIGURE 2-15c

Schematic Geologic Cross Section B-B'

DuPont East Chicago Current Conditions Report

CH2MHILL

E142837.EC.CC Cross Section C-C' 10-16-97mms/tll

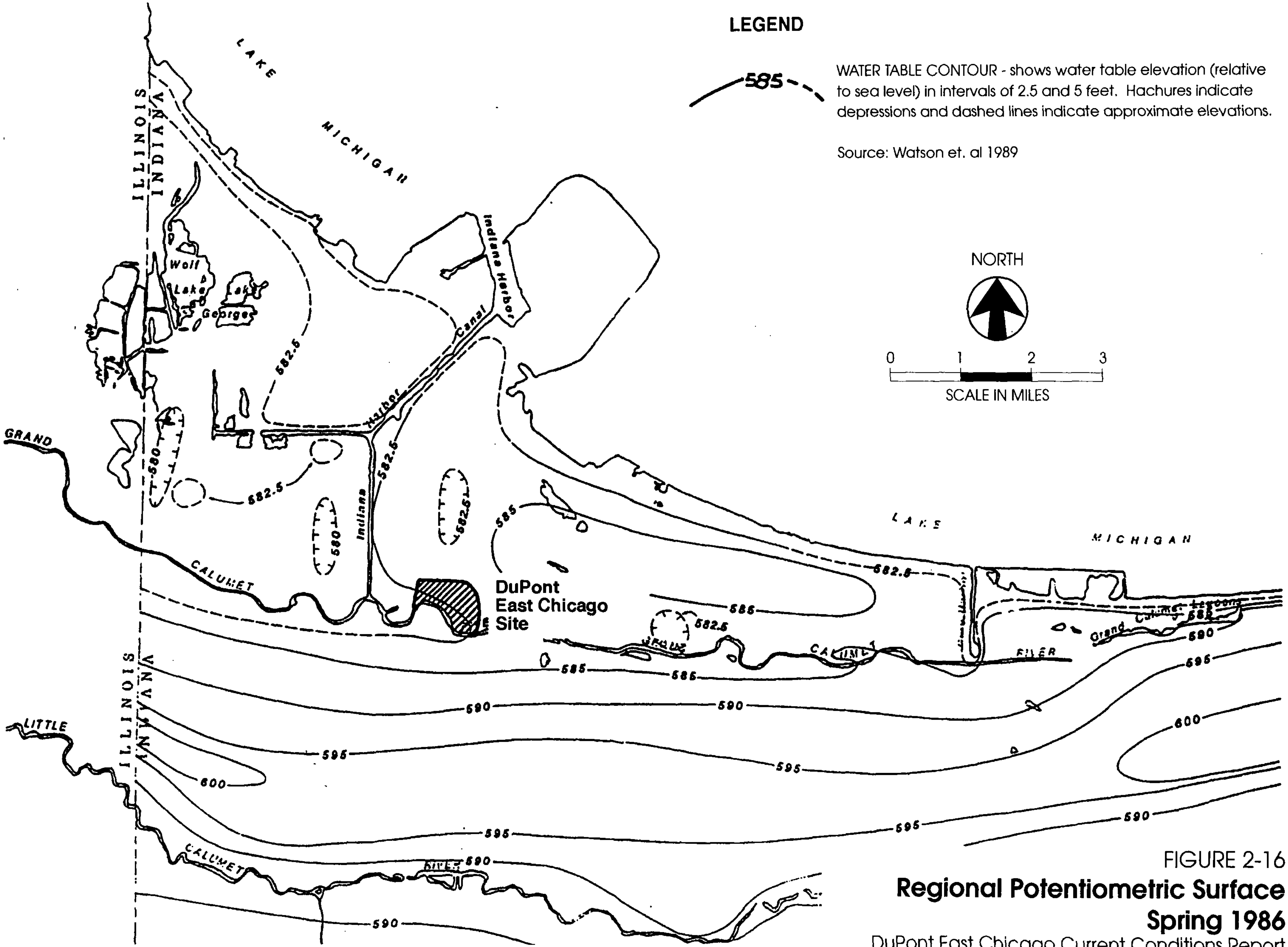
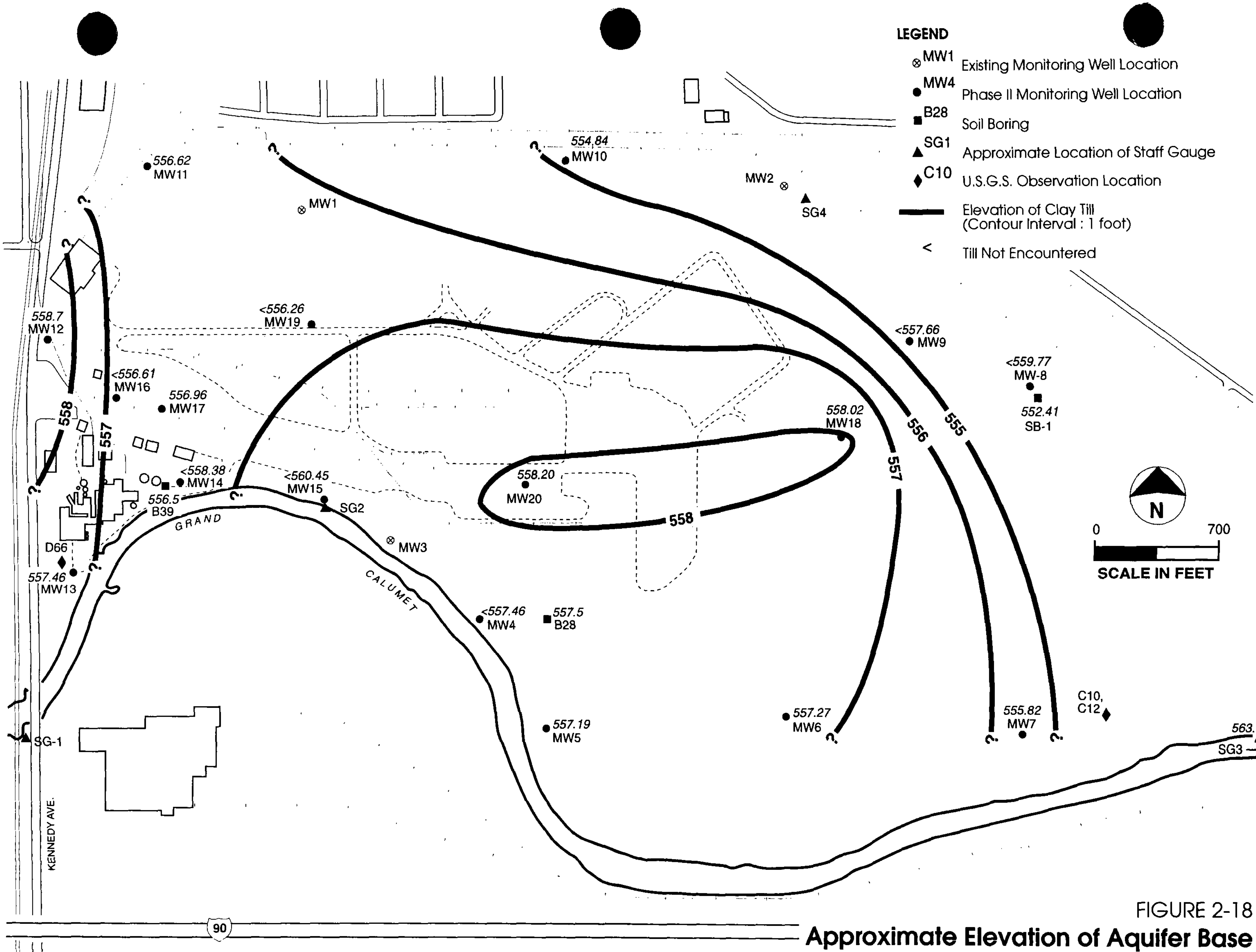


FIGURE 2-16
Regional Potentiometric Surface
Spring 1986
DuPont East Chicago Current Conditions Report

CH2MHILL



Source: CH2M HILL 1991

FIGURE 2-18
Approximate Elevation of Aquifer Base
DuPont East Chicago Current Conditions Report

CH2MHILL

E142837.EC.CC Approx Elev of Aquif Base 10-17-97mms/tll

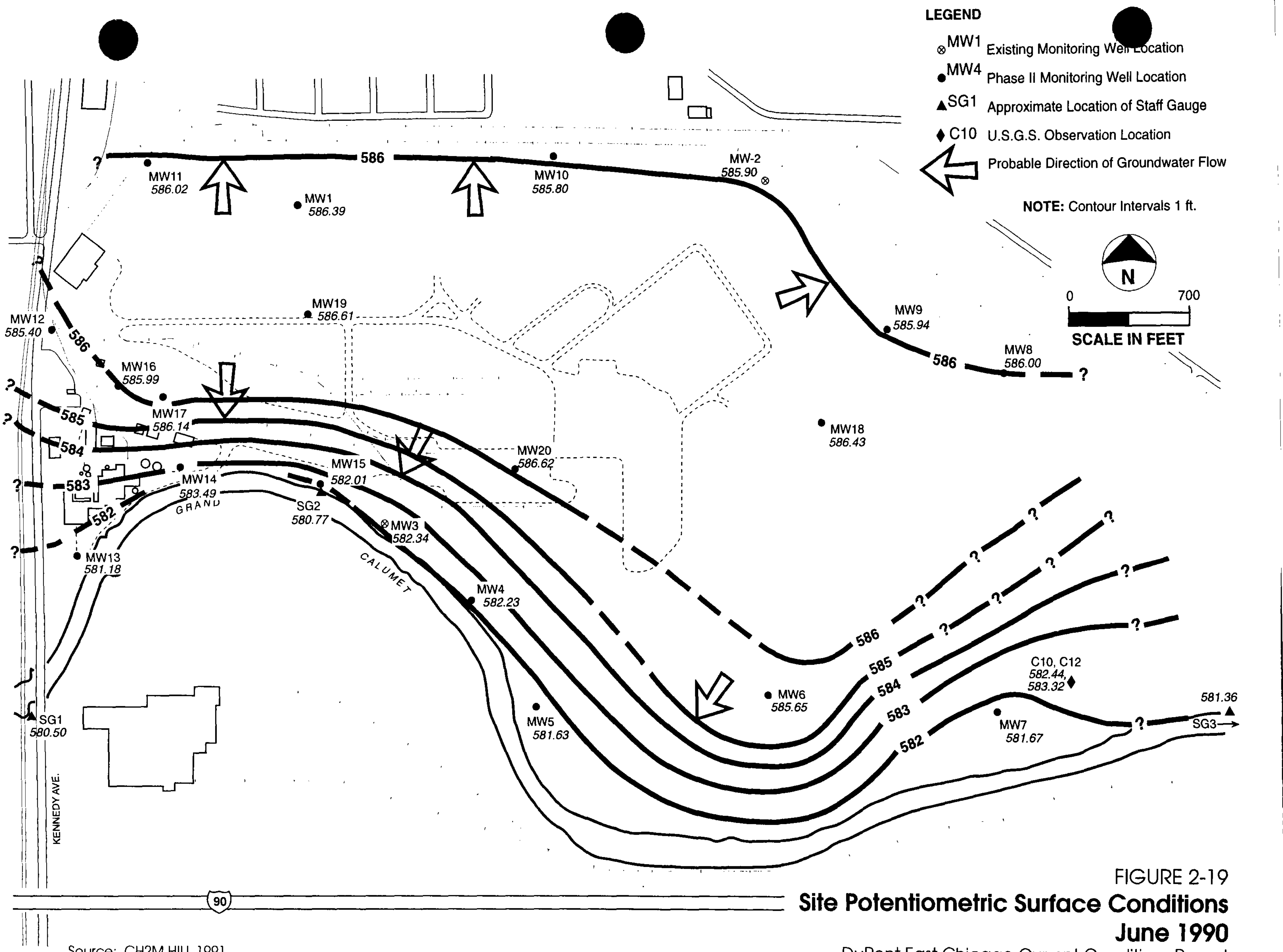
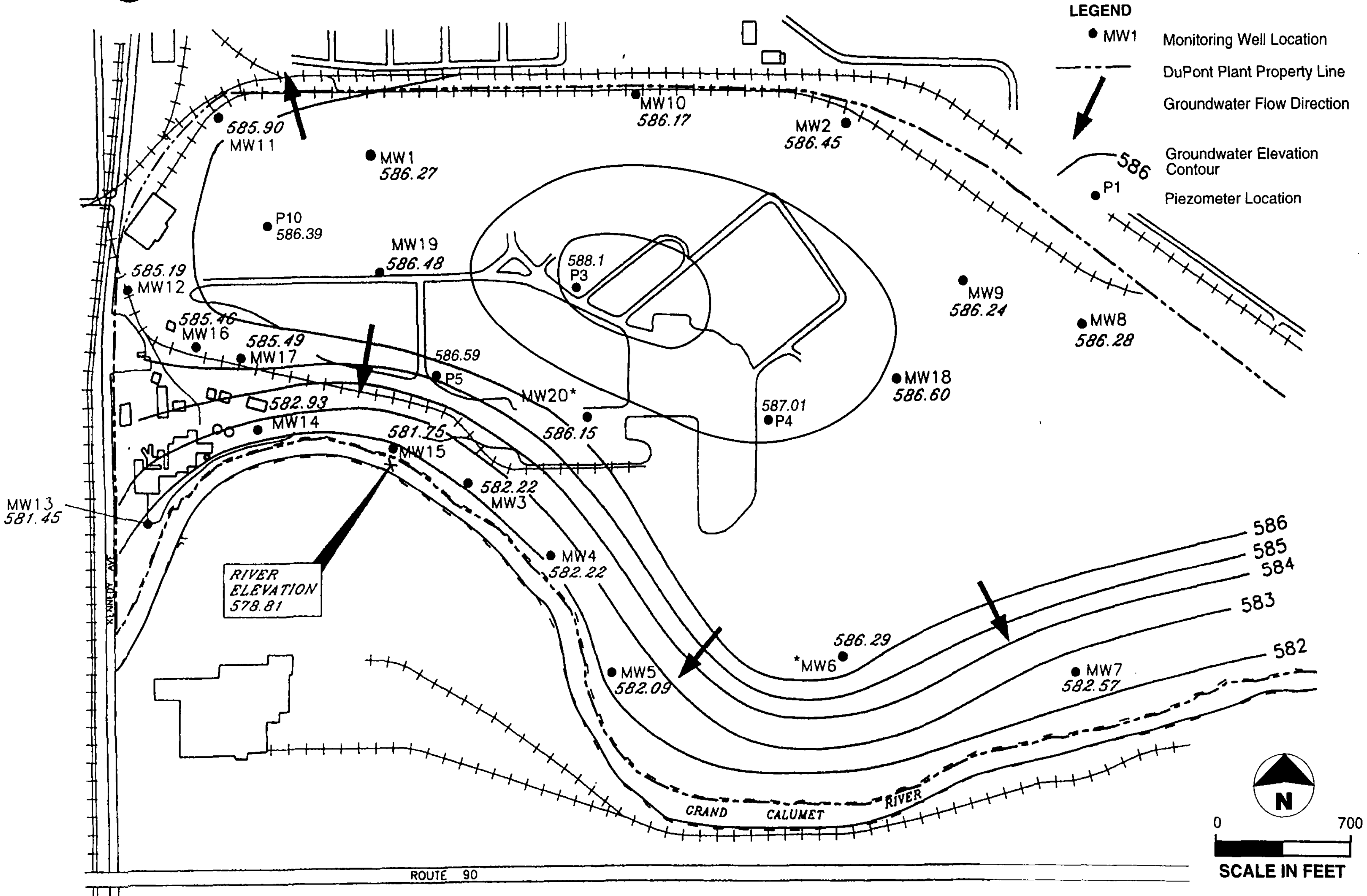


FIGURE 2-19
Site Potentiometric Surface Conditions
June 1990
DupPont East Chicago Current Conditions Report

Source: CH2M HILL 1991

CH2MHILL

E142837.EC.CC Potentio Surf Jun '90 10-17-97mms/tll



Source: DuPont

Note: All "MW" data were calculated using 1991 surveyed elevations. All were subsuquently surveyed in 1993. Those wells marked (*) are locations where the 1991 and 1993 survey data varied significantly. All survey data is included in the appendix.

FIGURE 2-20
Site Potentiometric Surface Conditions
March 1992
DuPont East Chicago Current Conditions Report

CH2MHILL

E142837.EC.CC Potentio Surf JUN '93 10-17-97mms/tll

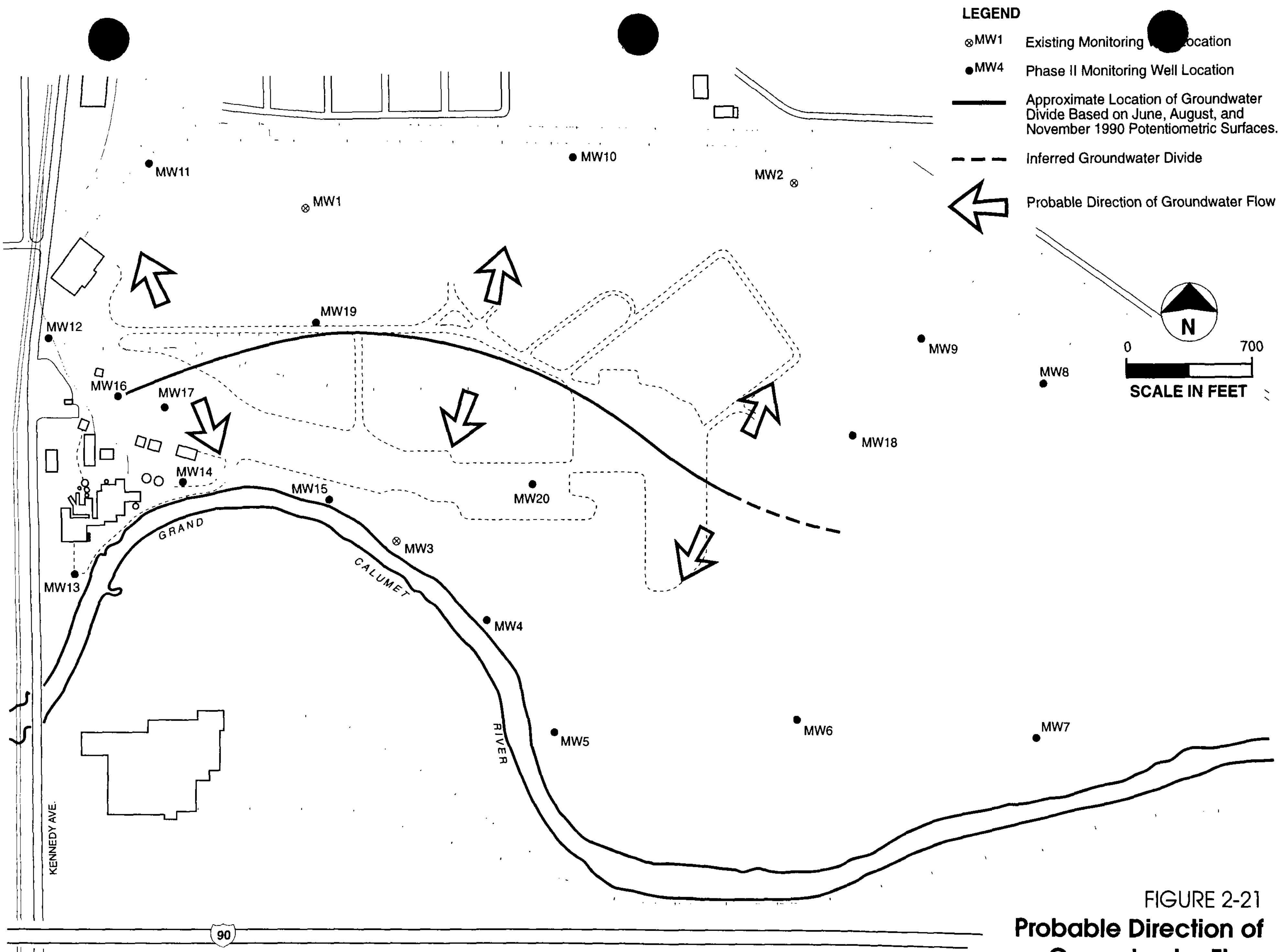


FIGURE 2-21

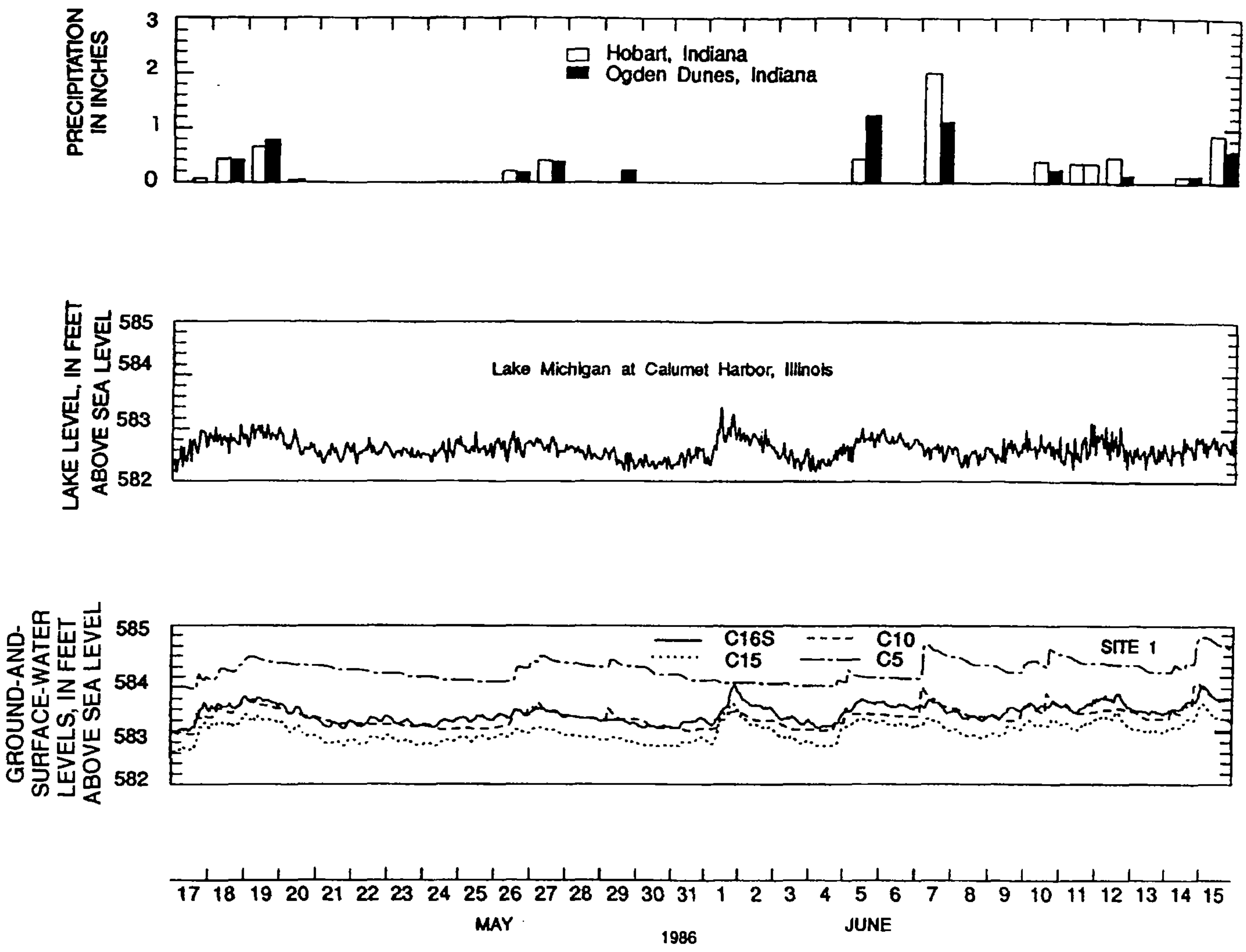
Probable Direction of Groundwater Flow

DuPont East Chicago Current Conditions Report

CH2MHILL

Source: CH2M HILL 1991

E142837.EC.CC Prob Direct of GW Flow 10-16-97mms/tll



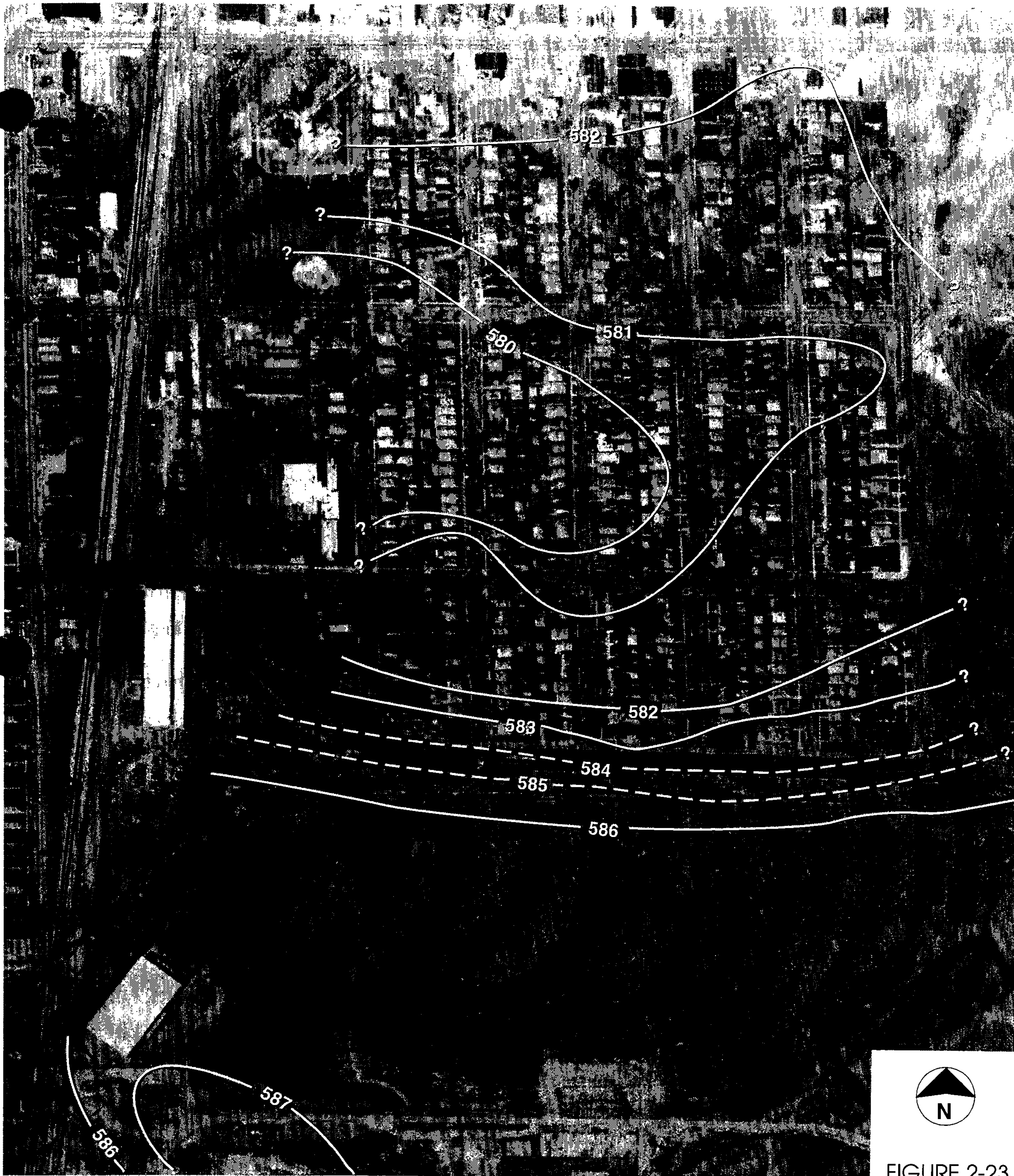
Source: Fenelon and Watson 1993

FIGURE 2-22

Surface Water and Groundwater Levels Near the DuPont Facility Compared to Lake Michigan Levels and Precipitation

DuPont East Chicago Current Conditions Report

CH2MHILL



LEGEND

Survey area potentiometric surface data from September 27-29, 1990 sewer infiltration observations.

DuPont facility potentiometric surface data from September 10, 1990 monitoring well water level measurements.

FIGURE 2-23

Site Potentiometric Surface, Riley Park and Northern Portion of DuPont Facility September 1990

DuPont East Chicago Current Conditions Report

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CHAPTER 3

Facility Operations

This chapter provides an overview of historic operations and waste management practices and identifies SWMUs and AOCs at the facility. Most of this information is presented in tables, including summaries of waste management practices, environmental permits, agency information requests, and interim stabilization measures taken to date. The locations of SWMUs and AOCs at the facility, identified in accordance with the RCRA corrective action program, are illustrated in the figures. The appendixes in Volume 2 contain supporting information such as details on production processes, SWMU and AOC determinations, and cross references to waste management units identified in previous reports.

Facility History

Grasselli Corporation constructed an inorganic chemical manufacturing plant at the site in 1892, and manufacturing began in 1893. DuPont operated the facility for Grasselli from 1927 through 1936. Grasselli formally deeded the entire property to DuPont on October 31, 1936, and the facility has since been owned and operated by DuPont. Since that time, DuPont deeded one parcel to the Chicago, South Shore, South Bend Railroad on May 29, 1942, and another to the Indiana Toll Road Commission on March 12, 1956. DuPont established a trailer transfer center on the northwest corner of the property in the early 1980s, which operated until the early 1990s. At that time the building and property were used for x-ray photographic film recycling activities. The silver recovery system ceased operating in 1995. This area is referred to in this report as the Conoco area. Available information regarding leases and rights-of-way is provided in Volume 2.

The facility expanded significantly between 1893 and 1945. By 1930, it covered roughly 160 acres. During World War II, it employed 2,000 workers and operated 21 production lines. Operations peaked around 1945 and began to decline after the war. Between 1950 and 1970, the facility employed 700 workers. In 1990, it employed 52 workers in the manufacture of two products—sodium silicate and colloidal silica. Manufacturing operations, including all support activities, now cover 28 acres in the southwest corner of the site. The current workforce is about 40 employees.

Production History

Over its 105-year lifetime, the East Chicago facility produced more than 100 products, primarily inorganic acids and chemicals (e.g., sulfuric, nitric, hydrochloric, phosphoric, and fluorosulfonic acid); various chloride, ammonia, and zinc products; and inorganic agricultural chemicals. Organic chemical manufacturing began in the 1948, after more than 50 years of plant operation, and ended in 1986. Organic chemical manufacturing consisted primarily of trichlorofluoromethane (TCFM) or Freon® products. Freon production by DuPont was begun at the federal government's request. In addition, several organic herbicides and insecticides (e.g., hexazinone) were also manufactured.

The facility now manufacturers a colloidal silica product (Ludox®) and sodium silicate solution. Its Standard Industrial Code (SIC) is 2819 for General Inorganic Chemicals. These products are used in x-ray film, photographic paper, pigments, nonslip coatings, low phosphate detergents, and metal castings for aerospace, medical, and recreational products.

Manufacturing operations and land use at the facility have changed over its 105-year life in response to changes in the marketplace. Figure 3-1 shows some of the changes in the number of production lines since 1893. The number of production lines was greatest—twenty-three—around 1945. Volume 2 of this report contains process flow diagrams for the major manufacturing operations. A generalized list of products with production history longer than 25 years is shown in Figure 3-2. A listing of all production lines and manufacturing dates is contained in Volume 2.

A photograph of the plant taken in 1927 (Figure 3-3) shows the areas where various chemicals were produced. The major manufacturing areas at the peak of operations are identified in Figure 3-4. Table 3-1 identifies the primary product components and trace constituents in products and waste streams handled at the facility. In Volume 2 a more detailed summary of the various raw materials, products, and waste streams at each manufacturing area is presented. The 1990 aerial photograph (see Figure 2-3) shows the extent of downsizing and decommissioning of manufacturing operations that has occurred at the plant since the mid-1940s.

Waste Management Practices

DuPont managed wastes at the facility according to general industry practices at the time. DuPont began modifying its waste management practices in the 1970s as environmental regulations were enacted and in response to regulatory changes and improved knowledge regarding the relationship between practices and potential effects on the environment. The following subsections provide an overview of waste management operations and the changes through the years as regulatory programs developed. An overview of changes in waste management practices is summarized in Table 3-2.

Records of early operations and practices at the facility are nonexistent. Some information is available on operations since the 1980s and most of the available information on waste management practices was summarized in the report titled Phase I Groundwater Assessment (CH2M HILL 1990). Accurate estimates of historic wastes generated and total quantities disposed or discharged could not be obtained from review of readily available information. Approximate estimates of waste quantities generated are contained in Volume 2.

Process Wastewaters

Flow in the East Branch of the Grand Calumet System, both historically and today, has consisted almost entirely of industrial effluents. Process wastewater at the DuPont facility discharged to the East Branch through several outfalls until the early 1970s. At that time, DuPont consolidated its discharges into three outfalls (001, 002, and 003). Storm sewers were separated from process sewers, and the process sewers were combined to provide wastewater treatment before discharge. Outfall 001 was for noncontact cooling water discharge from the Freon and acid manufacturing areas near the east end of the plant, and the other two were for process water. Outfall 001 was discontinued in 1984. Outfall 002 conveyed treated wastewaters from the Freon, sulfuric acid, sulfamic acid, and the AgChem manufacturing areas. The waste streams were treated by neutralization, settling, and filtration. Calcium fluoride was produced as a precipitate. Outfall 002 was shut down in April 1989 when the associated manufacturing operations were discontinued. Outfall 003 served the chlorides and silicate products manufacturing areas.

The treatment system (upstream of Outfall 003) consisted of flocculation, thickening, and filtration before discharge. A vacuum filter was provided for sludge dewatering. Wastewaters from the system were blended with treated wastewater from the Ludox process. They received final pH adjustment and filtration before discharge. Treatment of the Ludox wastewaters consisted of neutralization and filtration. Outfall 003 is still used today, but all other outfalls were abandoned when they were no longer needed. The current discharge rate for Outfall 003 is 420,000 gallons per day. Figure 3-5 shows the locations of the former and existing outfalls. It also shows the location of a water intake line that was used to pump noncontact cooling water from the East Branch (about 5,000 gpm). (This water was also used in the past for fire protection.) The water intake was abandoned in 1984.

Sanitary Wastes

Sanitary waste is conveyed to the East Chicago Sanitary District sewage treatment plant. Facility records indicate that discharge of sanitary wastes began in the mid-1940s. Facility records indicate that sometime after 1973, noncontact water from steam generation (boiler blowdown) and air compressors also were discharged by a separate sewer to the sanitary sewerage system. During the decommissioning of various manufacturing operations, the corresponding sanitary sewers were abandoned.

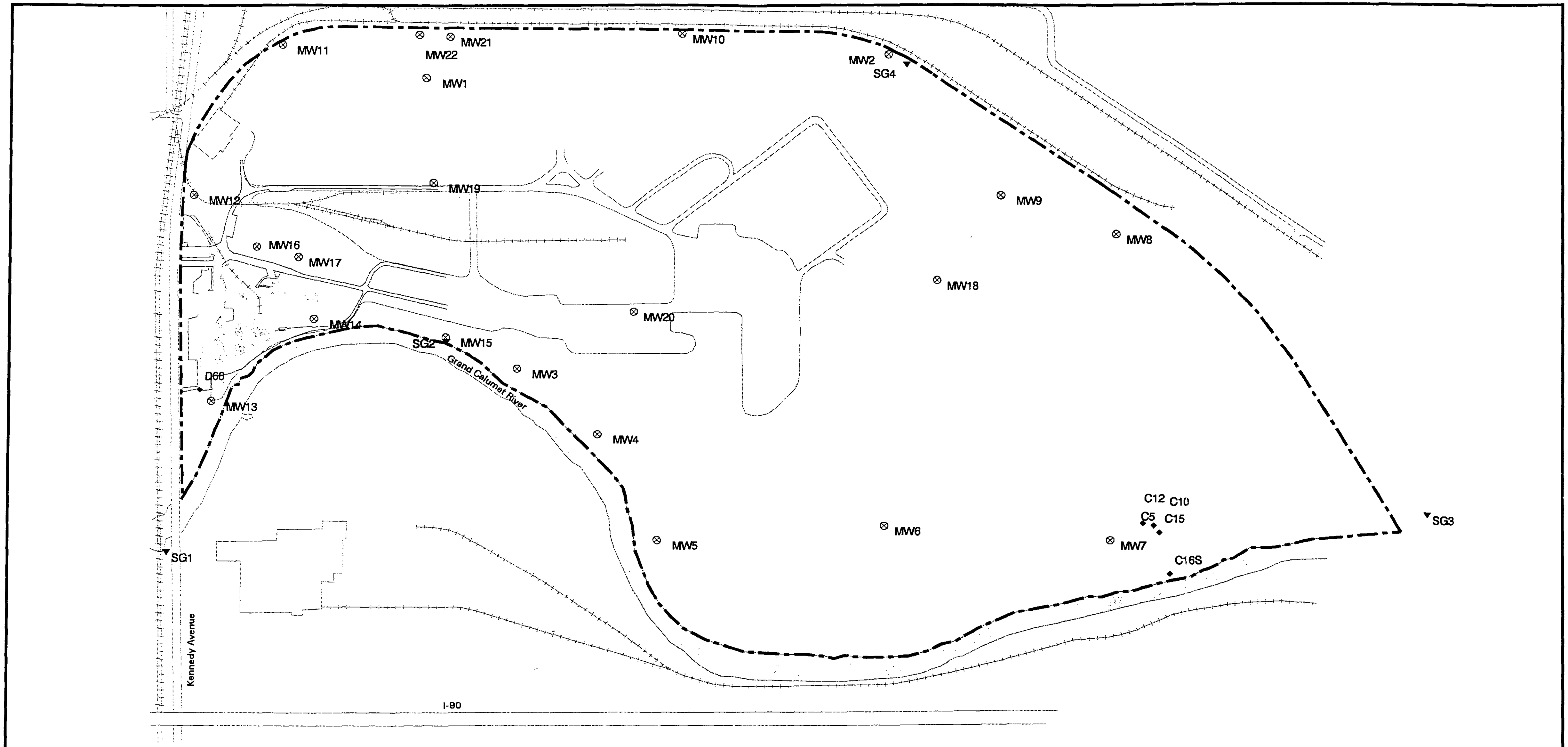
Stormwater Runoff

Most storm sewers and process sewers were combined before 1973. In mid-1974, stormwater was separated from process water for discharge to two storm sewers, one serving the office, the other the chloride production area and the warehouse areas. Each storm sewer discharged to a infiltration ditch dug in the cinder-filled area north of the plant. Today, some of the stormwater from the silicates products area is routed to the wastewater treatment system that discharges to Outfall 003. The stormwater from the rest of the area discharges through Outfall 004, which was installed and permitted for stormwater runoff in 1992.

The facility implemented an emergency spill control program in 1985. The manual describing emergency procedures was initially written in 1985 and revised in 1990. If a liquid spills on paved areas in the active manufacturing area and flows toward Outfall 004, facility personnel are to follow procedures to prevent discharge of spilled fluids to the East Branch.

Land Disposal Practices

Before RCRA was enacted, most industries disposed of wastes, such as general refuse, industrial wastes, and construction debris, in onsite pits, lagoons, waste piles, and so on. At the DuPont facility, waste materials from some manufacturing processes were disposed of on land north of manufacturing operations. As a general practice, similar waste types were segregated and placed in select locations. The common waste types disposed of consisted of



Legend

DuPont Property Line

⊗ MW1 Monitoring Well Location and Identifier

▼ SG1 Surface Water Monitoring Location and Identifier

◆ C10 USGS Observation Location ("S" indicates staff gauge)

N

Scale 1:7200
1 inch = 600 feet

Sources:
CH2M HILL

Figure 2-17
Site Monitoring Network

DuPont East Chicago Current Conditions Report

CH2MHILL

"October 18, 1997" esp217.aml

general refuse, wastewater treatment filter cake, process filter cake, ash, and construction debris. Historically, waste acids were neutralized in pits on the eastern edge of the manufacturing area and/or discharged to the East Branch.

Solids disposal increased significantly at the site with the operation of the wastewater treatment systems in the early 1970s. The dewatered solids, consisting mainly of calcium sulfate, silicates, calcium hydroxide, and calcium fluoride, were disposed in a diked area northeast of facility operations. A calcium silicate filter cake with a small amount of calcium sulfate currently is generated from the wastewater treatment system and disposed of in the onsite landfill. DuPont's request to IDEM for reclassification of the filter cake is pending. The material is expected to be classified under Indiana regulations as a nonrestricted, nonhazardous waste.

Demolition debris was generated during system modifications and dismantling of operating areas. Records documenting building dismantling and how construction debris was handled are not available. Much of the demolition debris was placed in the rubble fill area north of manufacturing operations. Some of the materials from building decommissioning were used to fill low spots in topography. Clear procedures for facility decommissioning were established in 1984. According to the procedures, process and storage tanks were cleaned by neutralization, residues were treated in the wastewater treatment system, and the tanks were sold as scrap. Scrap steel was generally given to the contractors as partial compensation.

Few wastes were disposed of offsite before 1975. Land disposal of general refuse, process solids, and semi-solids occurred north of manufacturing operations. Volume 2 contains more information on the contents of various land disposal units based on the Phase I Groundwater Assessment report (CH2M HILL 1990). After 1975, the facility sent certain waste offsite for disposal.

Organic wastes generated in the AgChem process were shipped offsite for incineration. Toluene still bottoms were distilled from a solution containing trace amounts of hexazinone in a hexane/toluene mixture. The remaining residues, referred to as "heel," were shipped offsite for toluene and hexane recovery and incineration. The wastes were stored onsite in a 4,000-gallon lined, carbon steel aboveground storage tank with a containment dike, referred to as the "waste solvent tank."

DuPont retained Safety Kleen to perform transport and disposal of spent solvents between 1979 and 1981. The facility used solvents primarily for maintenance operations and generated small quantities of waste solvents. Facility records indicate that before that time, some spent solvents (1,1,1-trichloroethane) were disposed of onsite in the past.

Air Emissions

Facility records indicate one instance of authorized disposal of liquid organic wastes by burning. In July 1972, DuPont received a conditional open burning permit from the City of East Chicago Department of Air Quality Control for burning about 1,000 drums of methyl ethyl ketone and organic sludge. The drums were believed to have been placed in the general refuse area of the rubble fill area and ignited.

Identification of SWMUs and AOCs

As part of the Phase I Groundwater Assessment report, waste management units (WMUs) were identified as locations where facility wastes, raw materials, or products were disposed of, treated, or stored. The term "waste management unit" is a misnomer for several units, because no "wastes" had ever been managed at many of those locations. From that list of WMUs, SWMUs and AOCs were identified in accordance with the definitions given in U.S. EPA's RCRA Corrective Action proposed regulations (see Volume 2). The identification of SWMUs and AOCs was based on the 1990 report unless more current information was obtained from discussion with plant personnel or review of facility records. Tables 3-3 and 3-4 list the areas at the DuPont facility designated as either SWMUs or AOCs, respectively. Figures 3-6 shows the SWMU locations with the exception of the process and sanitary sewers, which are shown in Figure 3-7. Figure 3-8 shows the locations of AOCs associated with spills at loading and unloading areas. Figure 3-9 shows the locations of spills associated with tanks and miscellaneous AOCs.

Cross references to the WMUs identified in the Phase I Groundwater Assessment Report are provided in Volume 2. WMUs were renumbered as either SWMUs or AOCs for the purposes of corrective action. An attempt was made to keep the former unit names unless a more descriptive name was appropriate. The WMUs were renumbered so that similar units had the same number but were distinguished by an alphabetic designation. For instance, all railroad loading and unloading areas are designated as AOC 2, with individual locations referred to as 2A, 2B, and so on. Some WMUs previously identified were determined to be neither SWMUs nor AOCs. The rationale for that determination is also presented in Volume 2. Tables in Volume 2 summarize the dates of operation for each unit, if known, and the possible contents or processes contributing to the wastes or releases from the units.

Environmental Compliance and Permits

Today wastes at the facility are managed under various regulatory programs and environmental permits. Sanitary wastes are discharged to the East Chicago Sanitary District. Process water is treated at an onsite wastewater treatment system before discharge through an outfall to the East Branch of the Grand Calumet System under an NPDES permit. The sludge from the wastewater treatment is dewatered and disposed of as a nonhazardous, solid waste filter cake. The filter cake is disposed of onsite in an engineered landfill. The landfill is a nonrestricted waste landfill. The facility is a conditionally exempt small quantity generator of hazardous wastes. Hazardous wastes are manifested under RCRA program and shipped to an offsite treatment and disposal facility. Air emissions at the facility from three boilers and one furnace are regulated under a pure synthetic minor operating permit. Table 3-5 lists past and current environmental permits for the facility.

Between 1991 and 1994, DuPont's East Chicago facility received extensive requests for information from the U.S. EPA. The requests were initiated under the authority of Section 104(e) of CERCLA and Section 3007 of RCRA with respect to potential releases at the site, and also under Section 308 of the Clean Water Act with regards to discharges to the East Branch. DuPont responded to the inquiries in a timely and thorough manner. The formal information requests concerning the East Chicago facility, and the dates of corresponding responses by DuPont, are summarized in Table 3-6.

Table 3-7 summarizes the environmental enforcement actions pertaining to the facility and the responses or actions undertaken by DuPont. DuPont signed a Consent Decree in November 1972 pursuant to the Clean Water Act. The facility is now responding to an environmental enforcement action that resulted in the signing of the Order in June 1997, initiating the RCRA Corrective Action Program at the facility.

Stabilization Measures Implementation

In the RCRA Corrective Action Program, stabilization or interim measures are actions taken to control or abate imminent or potential threats to human health or the environment. They are actions that may prevent or minimize the further spread of contamination while the need for long-term corrective measures is being evaluated. Over the years, DuPont has voluntarily implemented actions to control or minimize releases to the environment that could be considered stabilization measures (Table 3-8). DuPont took action in many instances, even though there was no imminent threat to human health or the environment.

As discussed in Chapter 5, based upon review of information available to prepare this report, there is currently no imminent threat to human health and the environment identified for the site, and thus, no new stabilization measures are proposed at this time. However, as further information is collected, DuPont will continue to evaluate the need for appropriate interim actions. To the extent possible, future stabilization measures are to be consistent with and integrated into the final corrective measures selected for the facility.

TABLE 3-1
Constituents Associated with Historic or Current Manufacturing Processes at the DuPont East Chicago Facility

Major Inorganics (Including some common metals)	
Aluminum	Nitrogen
Calcium	Phosphate
Carbonates	Silica
Chloride	Sodium
Fluoride	Sulfate
Iron	Sulfur
Trace Metals	
Antimony[a]	Copper
Arsenic	Lead
Barium	Nickel[a]
Boron[a]	Selenium[a]
Cadmium[a]	Vanadium[a]
Chromium	
Trace Inorganic	
Cyanide	
Organics	
Freon	Other Agricultural Chemicals:
Carbon Tetrachloride	Amines
Toluene	Ketones
Hexane	Phenols
Hexazinone	Urea

Note:
Chemicals associated with facility operations are not listed here (e.g. lubricants, cleaning liquids, soaps).

[a]Trace element present at low concentration in product or waste stream (not a primary component of product produced at facility). Other trace inorganics may be present in ores or raw materials at concentrations.

TABLE 3-2
Overview of Waste Management Practices

Waste Type	Historic Practice	Updated Practice[a]
Sanitary Wastewater	Discharge to waterway	Piped to East Chicago Sanitary System
Process Wastewater	Discharged through numerous outfalls	Treated before discharge (at first 3, then 1 outfall regulated under NPDES program)
Waste Acids	Neutralized and disposed of in pits onsite	Treated at WWTP or ceased operations
Waste Solvents	Burned in drums and onsite land disposal	Offsite disposal as hazardous waste
Solid Waste	Onsite land disposal	Offsite disposal
Ash	Onsite land disposal	Offsite disposal
Rubble and Building Materials	Onsite land disposal	Onsite land disposal
Stormwater Runoff	Infiltrated or directed toward low lying areas to north, east, and south (river)	Increased percent infiltration and limited discharge from the active manufacturing area
Wastewater Treatment Filter Cake	Onsite land disposal	Onsite land disposal

[a]Switched to these practices between early 1970s and early 1980s.

Source: *Phase I Groundwater Assessment* (CH2M HILL 1990) and DuPont records.

TABLE 3-3
Solid Waste Management Units Identified at the DuPont East Chicago Facility
(Page 1 of 3)

SWMU	Name	Description of Unit	Rationale for Unit Designation and Supplemental Comments*
1	Northern Onsite Waste Management Area		
1A	Ash Landfill/Stoker Grate Area	Former Land Disposal Area	
1B	Calcium Sulfate and TSP Area	Former Land Disposal Area	
1C	Rubble Fill Area	Former Land Disposal Area	
1D	Silica/Calcium Sulfate Area	Former Land Disposal Area for Waste Filtercake	
1E	Calcium Fluoride Area	Former Land Disposal Area	
1F	Zinc Mud Area	Former Land Disposal Area	
1G	General Refuse Area	Former Land Disposal Area and Former Open Burning Area	
1H	PCB Storage Area	In Rubble Fill Area	Wastes stored in this area
1I	Miscellaneous Pits and Piles—North	Former Land Disposal Area, red tainted area, located within SWMU 1A, the Ash Landfill/Stoker Grate Area.	This unit is contained in SWMU 1A and may be addressed as part of that SWMU
1J	Miscellaneous Pits and Piles—South	Former Land Disposal Area (red tainted area)	This unit is contained in SWMU 1A and may be addressed as part of that SWMU
1K	Spill Areas—South of Ash Landfill/Stoker Grate Area	Former Land Disposal Area	Facility records do not indicate the contents of the material placed in this area. The area is contained in the Ash Landfill/Stoker Grate Area
1L	New Landfill	Active Landfill for Wastewater Treatment Filter Cake	Closure activities also being addressed in an Interim Closure Plan being prepared at IDEM's request
2	Coal and Fly Ash Piles		
2A	Far West Pile	Former Fuel and Ash waste piles for Coal-fired Boiler Operations	
2B	West Pile	Former Fuel and Ash waste piles for Coal-fired Boiler Operations	
2C	East Pile	Former Fuel and Ash waste piles for Coal-fired Boiler Operations	

TABLE 3-3
Solid Waste Management Units Identified at the DuPont East Chicago Facility
(Page 2 of 3)

SWMU	Name	Description of Unit	Rationale for Unit Designation and Supplemental Comments*
2D	Far East Pile	Former Fuel and Ash waste piles for Coal-fired Boiler Operations	
3	Disposal Area Near Chrome Outfall	Former Land Disposal Area	
4	Insecticide Disposal Area	Former Land Disposal Area	
5	PCB Electrical Storage Yard	Building with concrete floor and curb near Contact No. 1	PCB waste and electrical equipment reportedly stored in this area
6	Hazardous Waste Storage Areas		
6A	Waste Solvent Tank	Former above ground waste solvent tank (4000-gal, lined carbon, steel)	Received waste solvents from AgChem production
6B	AgChem Drum Storage	Former drum storage area	
6C	Reagent Drum Storage	Former drum storage area	
6D	Flue Dust Storage in Adhesives Building	Former drum storage area	
6E	Flue Dust Storage near North Warehouse	Former drum storage area	
7	Abandoned Chemical Storage Building	Former building which received wastes and had a wood floor. Referred to as "The Morgue"	
8	Zinc Roaster Sinter Area	Former Land Disposal Area	
9	Incinerators		
9A	Northwest Incinerator	Former solid waste incinerator	Reportedly burned paper wastes from the plant. Ceased operations some time before the mid-1970s. Incinerator was dismantled and removed.
9B	Incinerator West of Freon Warehouse	Former solid waste incinerator	Reportedly burned paper wastes from the plant. Ceased operations some time before the mid-1970s. Incinerator was dismantled and removed.
10	HCl Neutralization Pit	Former industrial waste neutralization pit	Received acids that were neutralized with limestone in the pit. Also received arsenic, chromium, and antimony pentachloride catalyst.
11	Sulfamic Acid Pits (2)	Surface impoundments, concrete-lined pits	Received process waste and spilled sulfamic acid. Used for acid neutralization.

TABLE 3-3
Solid Waste Management Units Identified at the DuPont East Chicago Facility
(Page 3 of 3)

SWMU	Name	Description of Unit	Rationale for Unit Designation and Supplemental Comments[a]
12	Antimony Pentachloride Settling Basin	Surface Impoundment (approx. 6-ft-deep unlined)	Antimony pentachloride catalyst disposed in basin
13	Colloidal Silica Settling Pits (2)	Flow through surface impoundments for settling solids (silica particles) before influent enters EVC wastewater treatment system	
14	Chrome Outfall and Impoundment (Cooling Tower Blowdown)	Former outfall that was closed creating an impoundment, and was subsequently backfilled	The blowdown may have contained chrome at some time. The impoundment reportedly received overflow from neutralization pits.
15	Former Wastewater Treatment System	Wastewater treatment system and discharge to Outfall 002 to the Grand Calumet River	Part of the wastewater treatment system regulated under the NPDES program.
16	Current Wastewater Treatment System (Environmental Control System and Outfall 003)	Wastewater Treatment System Referred to as EVC and discharge to Outfall 003	Regulated under the NPDES program.
17	Process Sewers	Former French drains as well as abandoned sewer lines and current process sewers	
18	Sanitary Sewers	Abandoned and existing sanitary sewers	Addressed under the East Chicago Sanitary District regulations.
19	Building Maintenance Areas	Former cleaning solvent units, paints, and waste oils from maintenance operations stored within facility buildings	Most of these units were located inside buildings that have since been demolished. The exact locations of specific units are not known.
20	I-90 Fill Area	GCR was relocated for construction of I-90 by COE/DOT circa 1956, and fill was placed in this area based on aerial photo	
21	Lead Arsenate Sludge Disposal Area	Lead Arsenate sludge	AgChem Manufacturing
22	Former River Intake Canal	Earthen Canal and Former Land Disposal Area	Filled with debris from main office building demolition

[a]Designations are based on U.S. EPA's definition of SWMU and AOC from the July 15, 1985 (50 FR 28712), July 27, 1990 (55 FR 30798), and May 1, 1996 (61 FR 19432) *Federal Registers*.

Source: *Phase I Groundwater Assessment Report* (CH2M HILL 1990) and discussions with DuPont personnel.

TABLE 3-4
Areas of Concern (AOCs) Identified at the DuPont East Chicago Facility

AOC	Name	Description of Area	Rationale for Unit Designation and Supplemental Comments[a]
1 (A–G)	Vehicle Loading/ Unloading Areas	Loading and unloading areas (concrete, paved, dirt, or gravel) near various manufacturing buildings	Areas where spills were reported.
2 (A–G)	Railroad Loading and Unloading Areas	Loading and unloading for bulk chemicals from railcars near various manufacturing processes/buildings	Areas where spills were reported.
3 (A–J)	Aboveground Storage Tanks	Aboveground storage tank holding raw materials or products associated with various manufacturing operations	Areas where spills were reported.
4	Tank Car Neutralization Impoundment	One-time neutralization of fluorosulfonic acid offloaded from tank car into bermed area	This was a one-time occurrence. Fluorosulfonic acid was neutralized.
5	Beneath Former Contact No.1	Ground beneath former Contact No. 1 process area where vegetative cover has not been reestablished	Facility records do not indicate the contents of the material placed in this area.
6	Zinc Crude Milling Area	Process area	Spills reportedly occurred in this processing area.
7	Former Commercial Packing House Building	Former building which contained acid raw materials and products.	Acid spills reported to have occurred.
8	Former Powerhouse Pit	Former pit constructed of railroad ties	
9	Open Sanitary Ditch	Disposal of sanitary sewage in open ditch	This is a one-time occurrence.
10 (A–H)	Former Underground Storage Tanks	Underground steel storage tanks containing gasoline or fuel oil	Documentation of closure was unavailable, therefore USTs remain AOCs at this time. Four USTs were filled with gravel or removed.

[a]Designations are based on U.S. EPA's definition of SWMU and AOC from the July 15, 1985 (50 *FR* 28712), July 27, 1990 (55 *FR* 30798), and May 1, 1996 (61 *FR* 19432) *Federal Registers.*

Source: *Phase I Groundwater Assessment Report* (CH2M HILL 1990) and discussions with DuPont personnel.

TABLE 3-5
Permits and Permit Applications
(Page 1 of 2)

Permits Applied For and Received	Permit No. or Application No.	Regulated Operation	Comments
State of Indiana Discharge Permit Application (Pre-NPDES Permit)	IN 070 0X3-27208819	Wastewater discharges from Outfalls 001, 002, 003, 004, 005, 006, 007, 008,009, 010 (Outfall 006 removed in 11/1/72 revision)	Effective: 3/17/72 Revised: 11/1/72
NPDES Wastewater Permit	IN 0000329	Initial permit for effluent discharges through Outfalls 001, 002 and 003. Current discharges are for wastewater treated in the Environmental Control Treatment System (EVC) prior to discharge through Outfall 003. Some stormwater discharges are also permitted through Outfall 003. Outfall 001(noncontact cooling water discharge) discontinued in 1984. Outfall 002 permanently shut down 4/1/89.	Issued 10/31/74 Amended 3/24/76 Amended 8/27/76 Expired: 12/31/78 Reissued: 4/23/79 and Effective: 1/1/79 through 6/30/81 Issued: 3/29/85 Effective: 5/3/85 Expiration: 2/28/90 Automatic extension: 2/28/90 until new permit issued
Indiana Stream Pollution Control Board approval for the wastewater treatment system	I.W. Approval No. 880	Approval of wastewater treatment system plans submitted by DuPont.	Plans submitted 7/23/73 and 8/6/73 Approval 9/18/73
Sanitary Wastewater Permit for Discharge to the East Chicago Sanitary District	401	Sanitary wastewater discharge to the publicly owned treatment works (POTW).	Issued 4/18/86 Reissued:4/18/91 Expired 4/18/96
Army Corps of Engineers Permit for Dredging the Grand Calumet sediment	1731047	Dredging limestone and Grand Calumet sediments (500 cu. yds. from Mile 333.0). Dredging completed 9/14/73.	Application: 11/13/72 Effective: 7/16/73
Stormwater Permit	INR00E068	Stormwater discharges through Outfall 004. Initially obtained individual permit and subsequently received general permit. Outfall weir constructed in 1994.	Application 9/28/92 Issued: 9/29/92 Modification request: 5/9/96 and 7/1/96 Issued: 8/28/96

TABLE 3-5
Permits and Permit Applications
(Page 2 of 2)

Permits Applied For and Received	Permit No. or Application No.	Regulated Operation	Comments
City of East Chicago Open Burn Permit	None Referenced	Open burning of liquid organic waste contents of 1000 drums	Application: 7/28/72 Issued: 7/31/72 Expiration: 7/31/73
IDEM Air Emissions Permit	45-01-93-0472 45-01-93-0473	Emissions from (3) natural gas-fired Stone Johnson Boilers and (1) Sodium Silicate natural-gas fired furnace	Issued: 10/5/89 Effective 10/20/89 Expiration: 1/1/93
IDEM Air Operating Permit Application	61-50 (089-00310)	Application to be regulated as a pure synthetic minor source of emissions under the Title V Permit Program for operation of the boilers and furnace	Application: 7/24/97 Administrative completeness: 8/18/97
City of East Chicago Air Emissions Permit	1, 2, 3, and 4	Emission from Sodium Silicate Furnace, Powerhouse Boilers 1, 2, and 3	Expiration: 3/31/91
State of Indiana Underground Storage Tank Registration	011982-04016	Underground Storage Tank Registration for one tank	3/01/91
RCRA Hazardous Waste Permit (Part A)	IND005174354	Applied for hazardous waste permit as a generator and a storage facility. Subsequently, withdrew application for storing wastes more than 90 days and requested generator status only.	Application: 11/17/80 Withdrawal requested: 3/17/82 Withdrawal approved: 11/4/82
Landfill Permit Application	45-17	Land disposal of the wastewater treatment filter cake (calcium silicate and calcium sulfate) as a nonhazardous, unrestricted waste	IDEM approval letter: 1977 Application: 9/86 Reclassification requested: 12/96

Source: DuPont facility records.

TABLE 3-6
U.S. EPA Requests for Information and DuPont Responses

Request	Date of Request	Date of Response
U.S. EPA Request for Information on Solid Waste Disposal	April 1, 1980	April 29,1980
U.S. EPA Request for Information pursuant to Section 104(e) of CERCLA and Section 3007 of RCRA	September 13, 1991	November 22, 1991
U.S. EPA Request for Supplemental Information pursuant to Section 104(e) of CERCLA and Section 3007 of RCRA	October 1, 1992	January 29, 1993
Status Report on Producing Supplemental Information requested on October 1, 1992	NA	January 6, 1993
Request for Supplemental Information pursuant to Section 3007 of RCRA	July 8, 1993	September 10, 1993 September 17, 1993
Request for Meeting Subsequent to Review of Information submitted pursuant to Section 104(e) of CERCLA	February 28, 1994	
Indiana Department of Environmental Management Compliance Evaluation Inspection	April 28, 1994	June 2, 1994
U.S. EPA Information Request pursuant to Section 308 of the Clean Water Act	February 15, 1991	March 14, 1991
Amended U.S. EPA Information Request pursuant to Section 308 of the Clean Water Act	June 27, 199	February 13, 1991, and January 27, 1992
Section 308 CWA Information Request One-Time Monitoring Report		April 15, 1991
Section 308 CWA Information Request Monthly Monitoring Report		May 14, 1991
Section 308 CWA Information Request Monthly Monitoring Report		June 13, 1991
Section 308 CWA Information Request Monthly Monitoring Report		July 15, 1991
Section 308 CWA Information Request Monthly Monitoring Report		September 5, 1991
Section 308 CWA Information Request Monthly Monitoring Report		September 24, 1991
Section 308 CWA Information Request Monthly Monitoring Report		October 25, 1991
Section 308 CWA Information Request Monthly Monitoring Report		November 25, 1991
Section 308 CWA Information Request Monthly Monitoring Report		December 30, 1991
Section 308 CWA Information Request One-Time Monitoring Report		January 27, 1992
Section 308 CWA Information Request Monthly Monitoring Report		January 27, 1992
Section 308 CWA Information Request Monthly Monitoring Report		February 27, 1992
Section 308 CWA Information Request Monthly Monitoring Report		March 30, 1992
Section 308 CWA Information Request Monthly Monitoring Report		April 28, 1992
Section 308 CWA Information Request Monthly Monitoring Report		May 28, 1992
Section 308 CWA Information Request Monthly Monitoring Report		July 30, 1992

Source: Plant records and CH2M HILL records.

TABLE 3-7
Summary of Environmental Enforcement Actions at the DuPont East Chicago Facility

Action	Date	Description	Resolution	Date	Status
Civil Action	2/19/71	Injunction against continued discharge of effluent	Consent Decree	11/14/72	Order expired upon issuance of site's NPDES permit
Request for Adjudicatory Hearing and Stipulation	11/18/74	Request for hearing to contest NPDES permit	U.S. EPA and DuPont approval of stipulation	3/23/76	NPDES permit modified
Notice of Violation and Proposed Agreed Order	1/8/97	Notice of improper identification and storage of hazardous waste (flue dust and refractory brick)	Agreed Order on Consent for RCRA corrective action	6/26/97	Paid penalty and initiated RCRA corrective action

TABLE 3-8
Interim Stabilization Measures Conducted at the DuPont East Chicago Facility

Interim Stabilization Measure	Date	Brief Description of Stabilization Measures Undertaken
Sewer Abandonment	From mid-1900s through mid-1980s	DuPont abandoned process, storm, and sanitary sewers as manufacturing operations ceased or, later, when facilities were dismantled. Approximately 14,000 feet of process and storm sewers have been abandoned. Abandonment typically consisted of plugging the sewer at several locations along the pipeline and removal of piping at the waterway bank.
Consolidation of Outfalls	1974	DuPont plugged lines at catch basins; removed last 10 feet of piping near channel bank; filled in ("capped") end of pipe in place. When abandoning E-1, DuPont blocked off the discharge outlet and backfilled the last 20 feet of the drainage ditch.
Slurry Wall and Sheet Piling	Late 1990 early 1991	Sheet piling was driven to a depth of 20 feet through the abandoned process sewer and the backfill surrounding the pipe a distance of roughly 100 feet from the southern property boundary. In addition, DuPont excavated and removed the last 30 feet of existing pipeline (25 to 55 feet from the waterway). The pipeline was broken up in place, and the excavation was backfilled.
Filling of Pits and Ditches	1986 to 1987	DuPont filled former neutralization pits and ditches so that these areas would not collect water or convey water to other areas.
Closure of Underground Storage Tanks	1960s to 1990s	Eight petroleum USTs have been closed (filled in place or removed) to reduce the potential for release to groundwater.

Source: Section 308 Information Request Response 1991; Section 104(e) Information Request Response 1991; Meyer 1997.

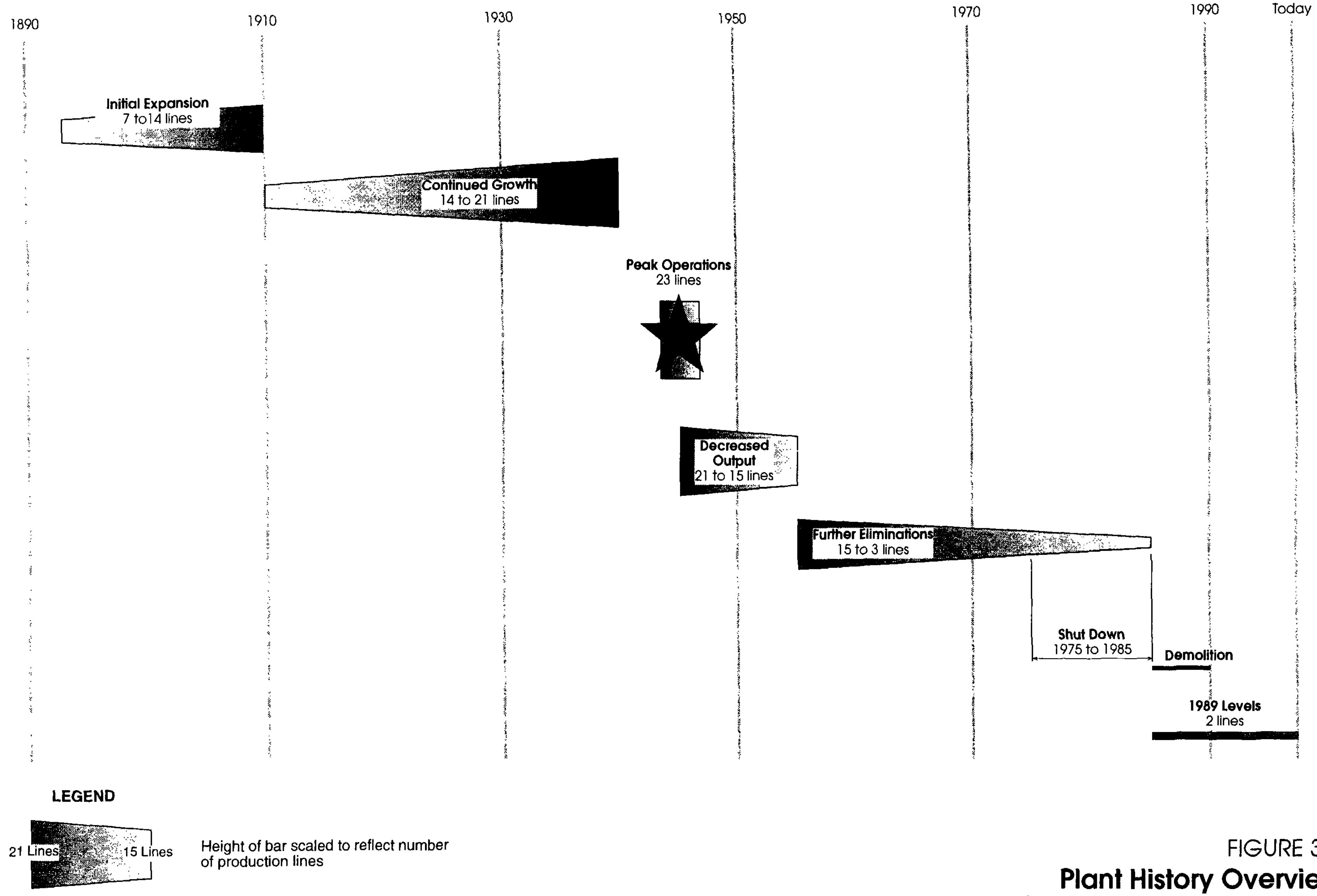
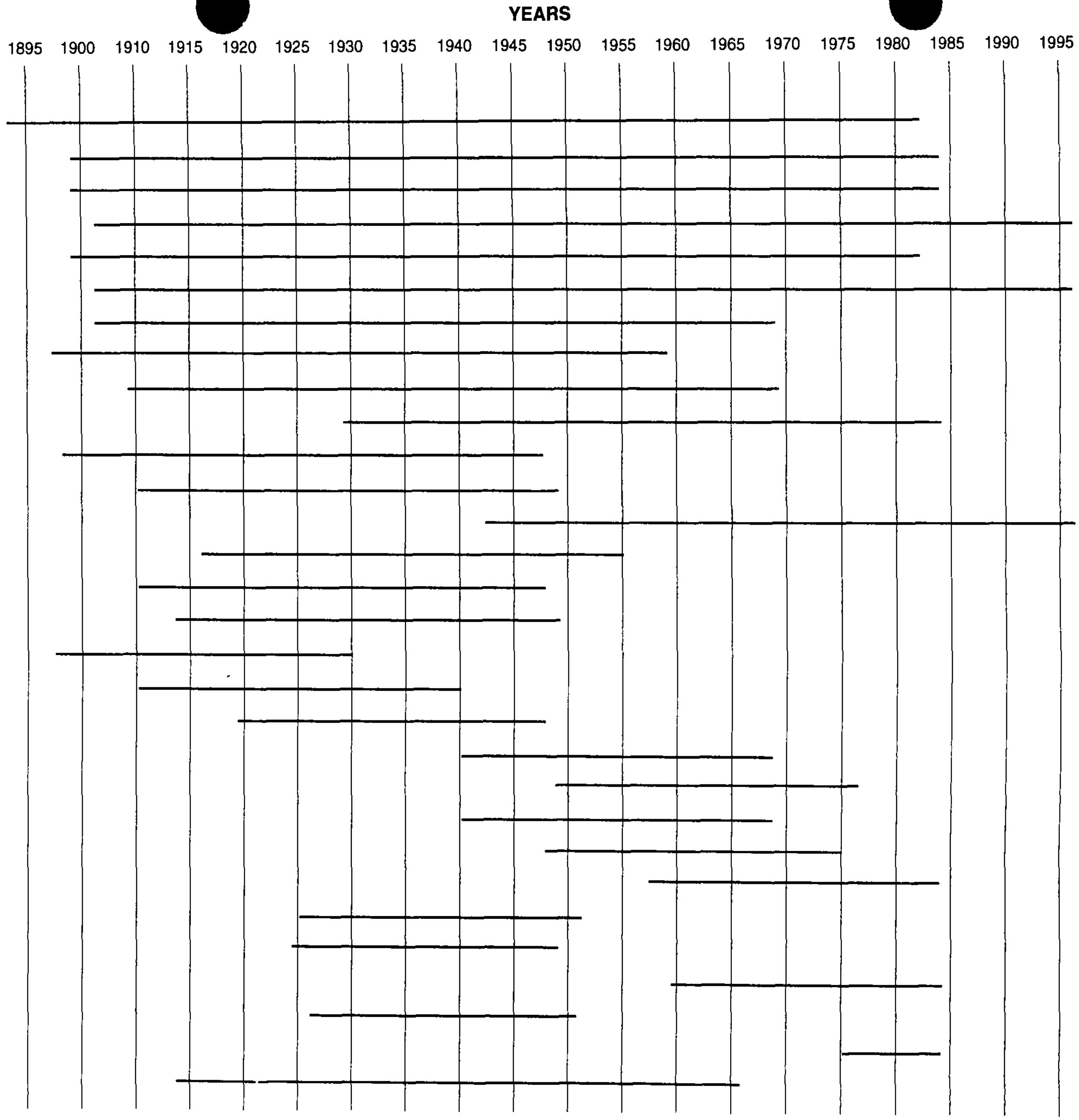


FIGURE 3-1
Plant History Overview
DuPont East Chicago Current Conditions Report

CH2MHILL

Products	Begin Operation	Discontinued Operation	Duration Years
Sulfuric Acid Products	1893	1984	91
Nitric Acid Reagent	1899	1984	85
Sulfuric Acid Reagent	1899	1984	85
Sodium Silicate Products	1902	*	95+
Hydrochloric Acid Reagent	1899	1982	83
Acetic Acid Reagent	1902	1982	80
Zinc Chloride Products	1902	1969	67
Hydrochloric Acid and Soil Cake Products	1897	1959	62
Ammonium Chloride Products	1909	1969	60
Duclean Inhibited Acid Products	1929	1984	55
Glauber's Salt	1898	1948	50
Lead Arsenate Products	1910	1949	39
Colloidal Silica Products	1947	*	50+
Sodium Thiosulfate	1916	1955	39
Lime Sulfur Solution	1910	1948	38
Arsenic Acid	1914	1949	35
Mixed Acid	1897	1930	33
Bordeaux Mixture® Insecticide	1910	1940	30
Calcium Arsenate	1919	1948	29
Chromated Zinc Chloride Products	1940	1969	29
Trichlorofluoromethane-Kinetics Operation	1948	1977	29
Zinc Ammonium Chloride Products	1940	1969	29
Aluminum Chloride Products	1947	1975	28
Ammonium Hydroxide Reagent - New Facilities	1958	1984	26
Phosphoric Acid	1925	1951	26
Litharge®	1924	1949	25
Sulfamic Acid	1959	1984	25
Disodium Phosphate Products	1926	1951	25
Fluorosulfonic Acid	1975	1988	13
Zinc Ore Roasters	1913	1967	54



* Products still being produced

Source: Phase I Groundwater Assessment Report (CH2M HILL, 1990)
and New DuPont Information

FIGURE 3-2
General Production History for Products in Production Longer Than 25 Years
DuPont East Chicago Current Conditions Report
CH2MHILL

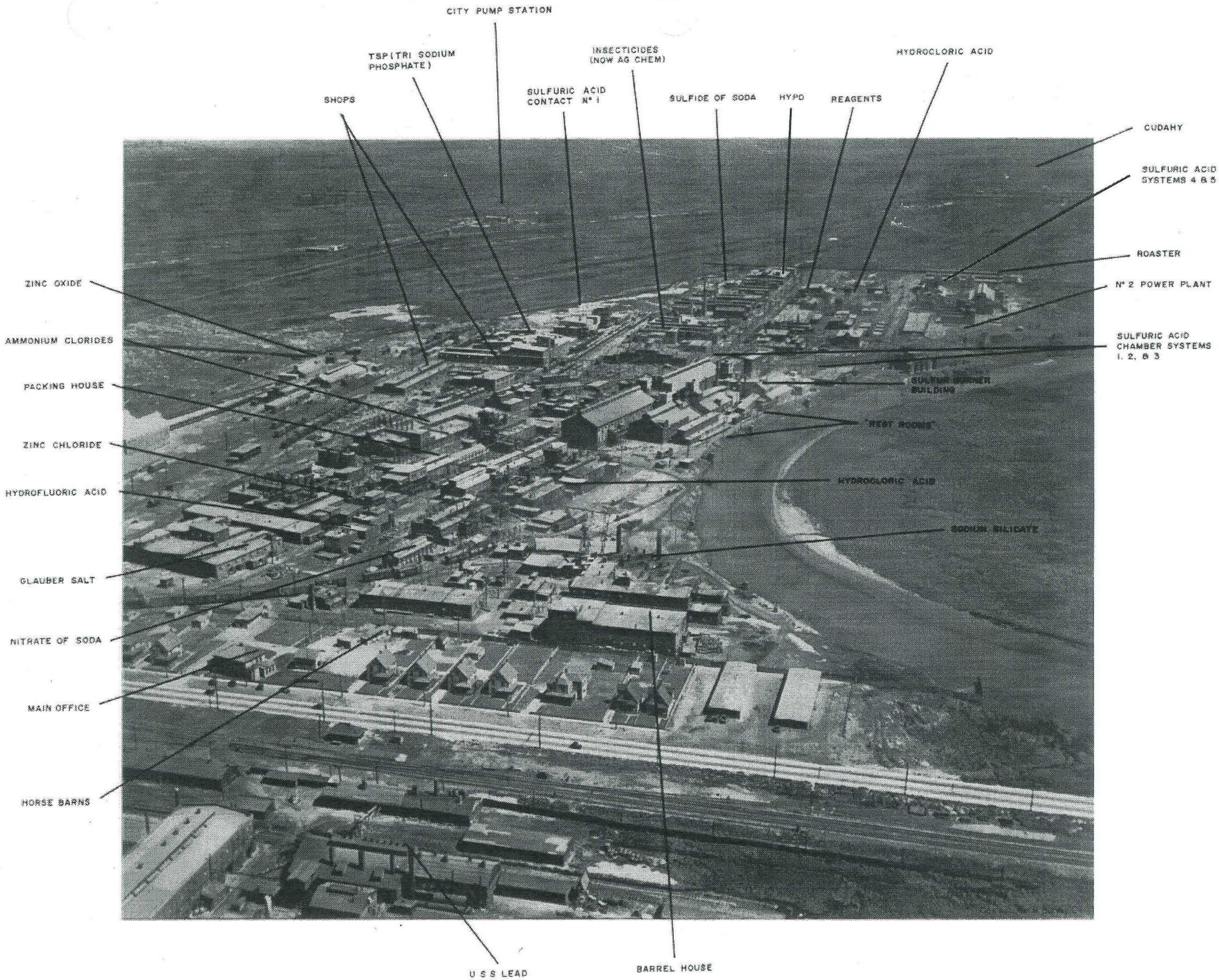
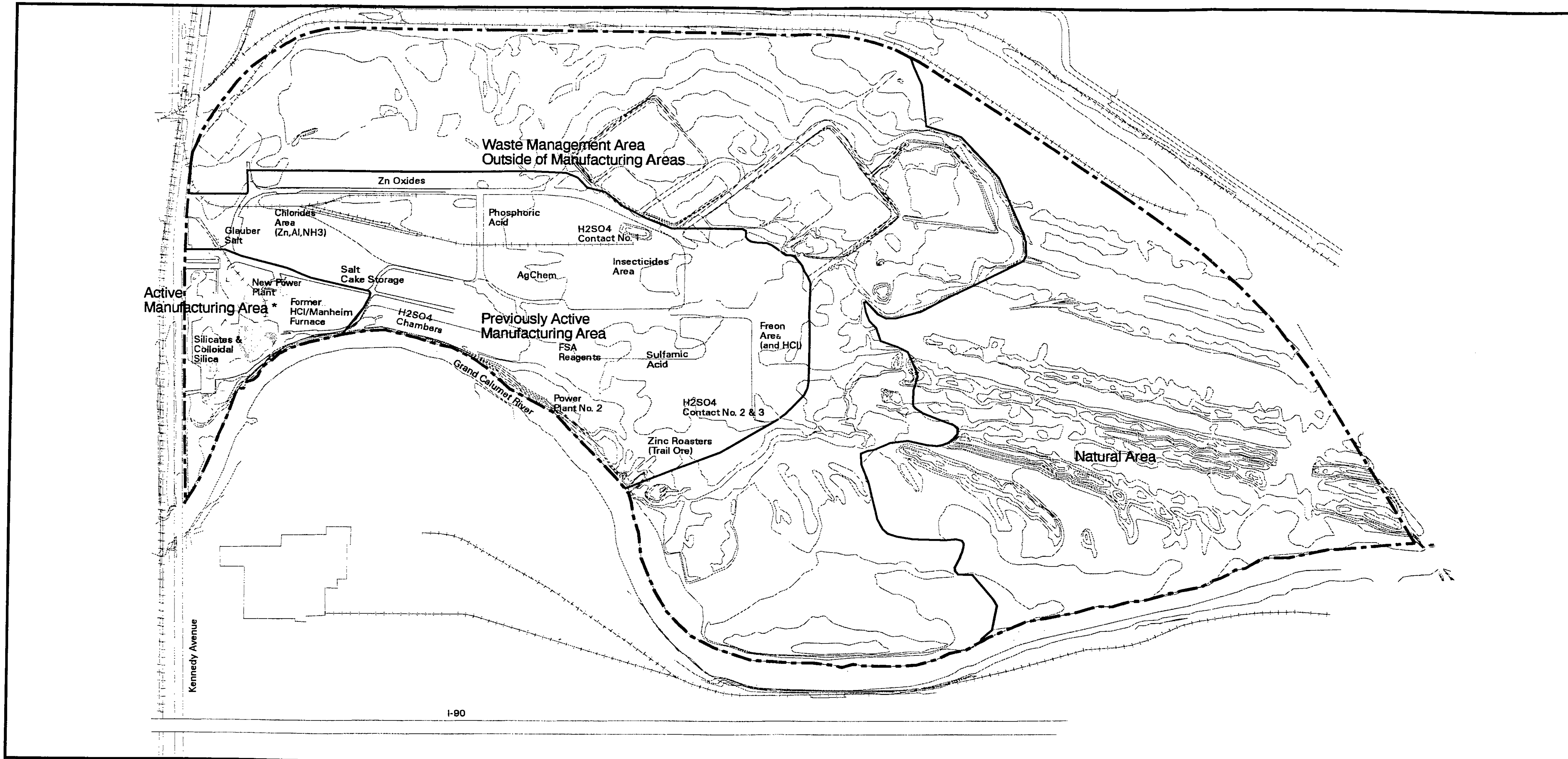


FIGURE 3-3
1927 Aerial Photograph of Site
DuPont East Chicago Current Conditions Report

CH2MHILL



Legend

- DuPont Property Line
- Contours - 2 ft Interval
- Area Boundaries
- * Silicates and Colloidal Silica

Note:
Southwest boundary of natural areas was shifted east based on fill deposited during relocation of Grand Calumet River for construction of I-90

N

Scale 1:7200
1 inch = 600 feet

Sources:
Plant Drawings

Figure 3-4
Historic Manufacturing Areas Within the Plant

DuPont East Chicago Current Conditions Report

CH2MHILL

"October 22, 1997" map34.aml

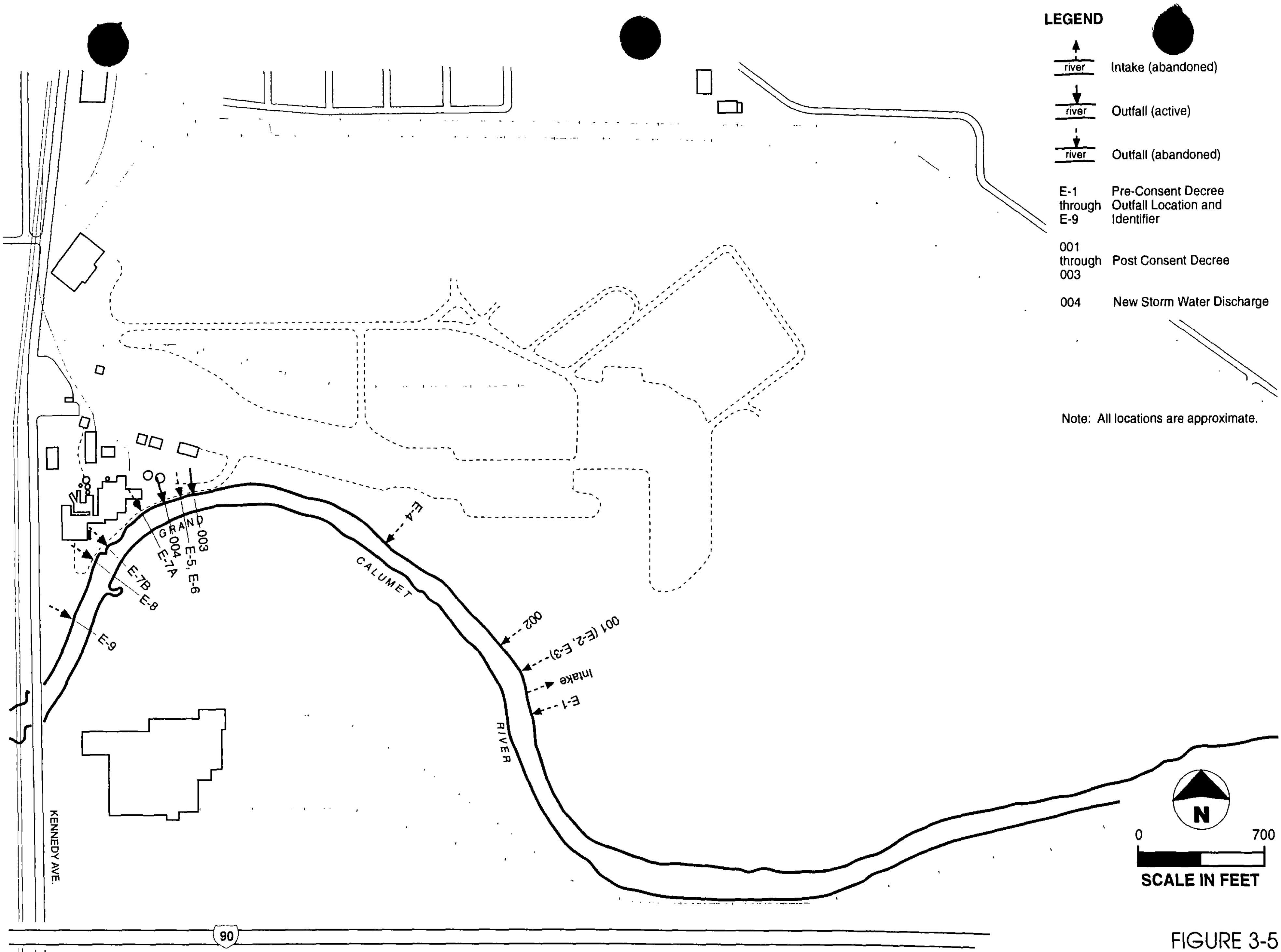
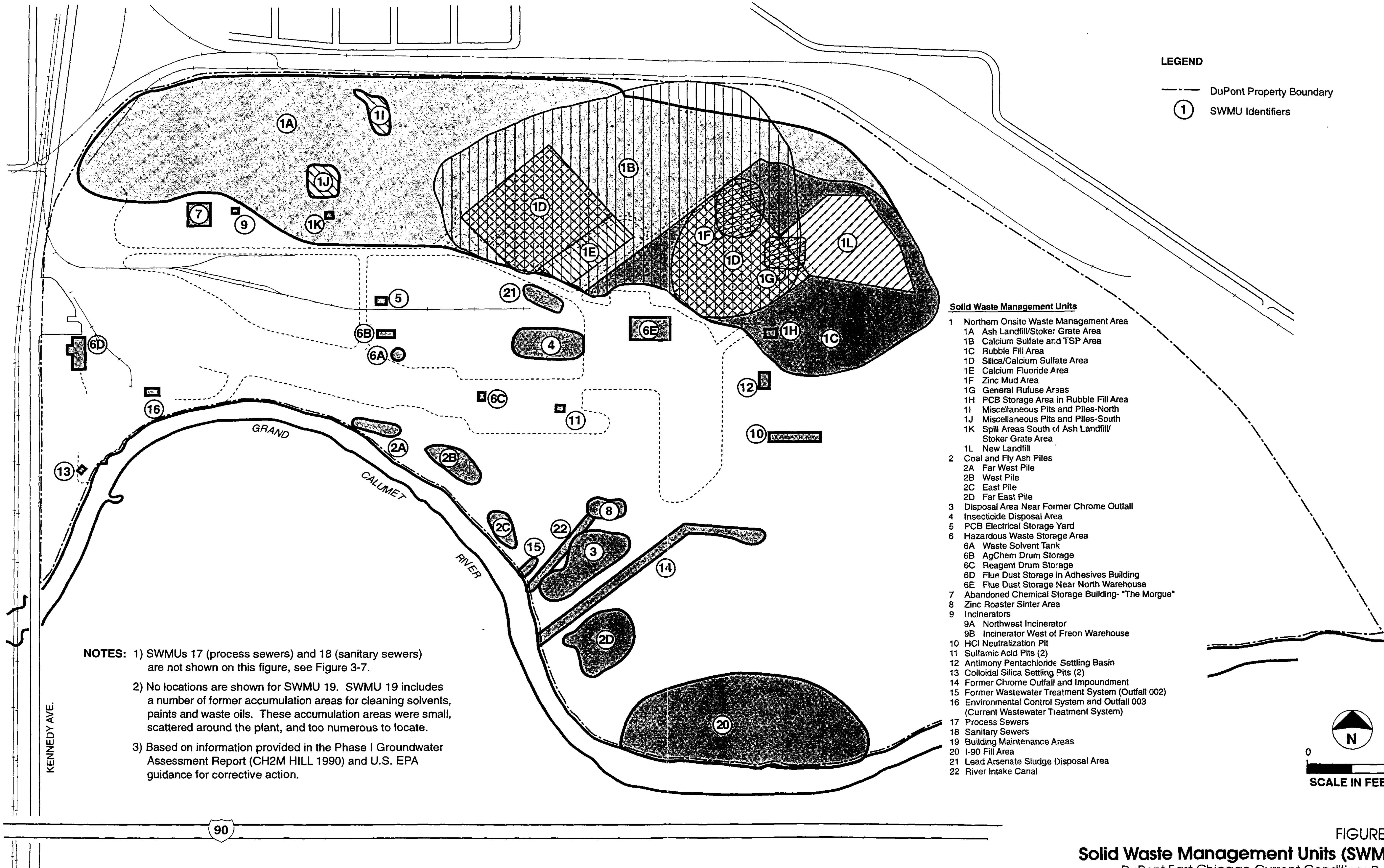


FIGURE 3-5
Water Intake and Outfalls
DuPont East Chicago Current Conditions Report
CH2MHILL

Source: 1) Plans prepared after DuPont East Chicago Plant, Consent Decree, November 1972
2) DuPont East Chicago Plant, West Process Waste Outfall Plot Plan, 1973
3) 1970 Aerial Photograph

E142837.EC.CC Water Intake 10-21-97tll



Solid Waste Management Units

1 Northern Onsite Waste Management Area
- 1A Ash Landfill/Stoker Grate Area
- 1B Calcium Sulfate and TSP Area
- 1C Rubble Fill Area
- 1D Silica/Calcium Sulfate Area
- 1E Calcium Fluoride Area
- 1F Zinc Mud Area
- 1G General Rufuse Areas
- 1H PCB Storage Area in Rubble Fill Area
- 1I Miscellaneous Pits and Piles-North
- 1J Miscellaneous Pits and Piles-South
- 1K Spill Areas South of Ash Landfill/ Stoker Grate Area
- 1L New Landfill

2 Coal and Fly Ash Piles
- 2A Far West Pile
- 2B West Pile
- 2C East Pile
- 2D Far East Pile

3 Disposal Area Near Former Chrome Outfall
4 Insecticide Disposal Area
5 PCB Electrical Storage Yard
6 Hazardous Waste Storage Area
- 6A Waste Solvent Tank
- 6B AgChem Drum Storage
- 6C Reagent Drum Storage
- 6D Flue Dust Storage in Adhesives Building
- 6E Flue Dust Storage Near North Warehouse

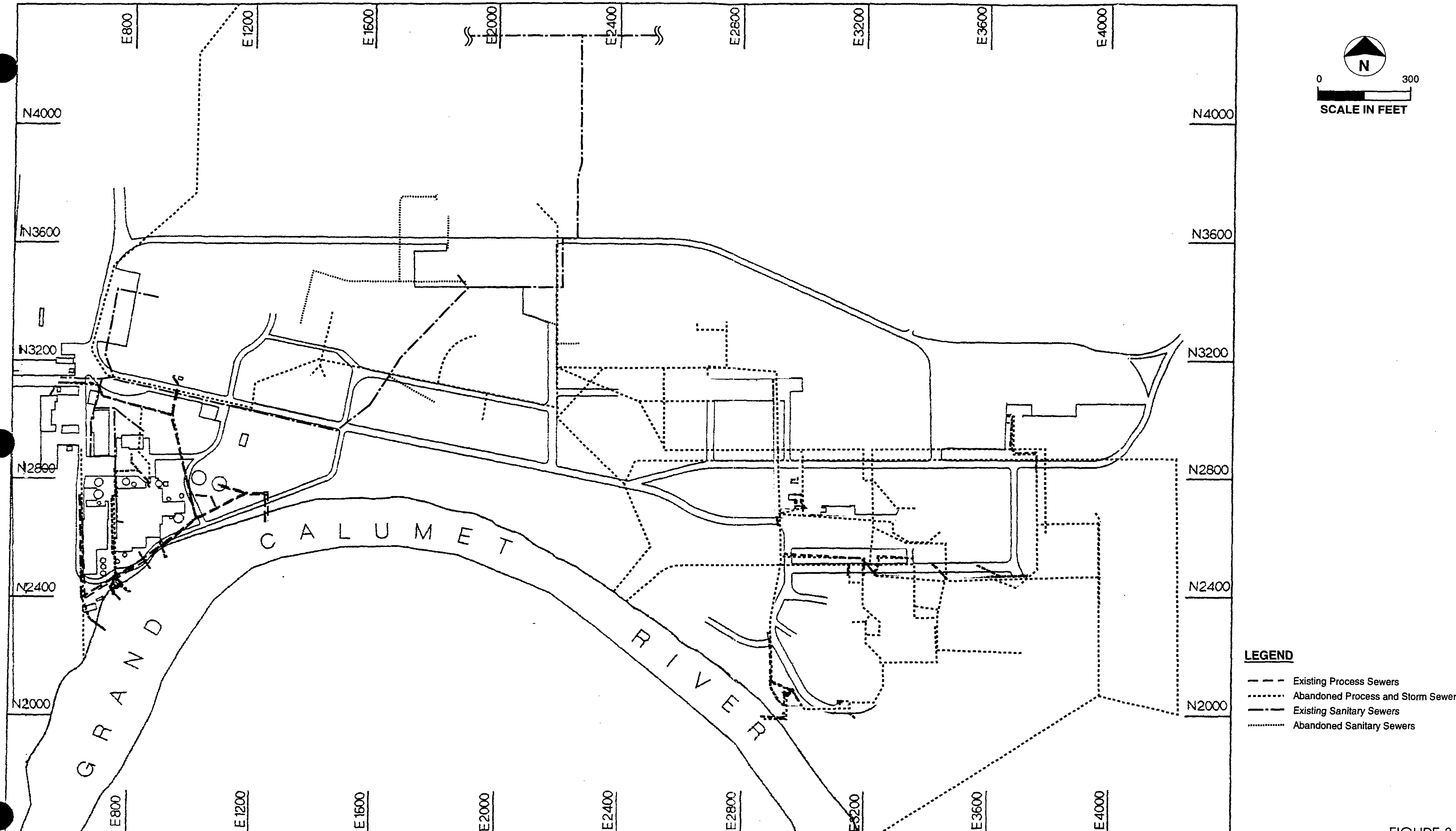
7 Abandoned Chemical Storage Building- "The Morgue"
8 Zinc Roaster Sinter Area
9 Incinerators
- 9A Northwest Incinerator
- 9B Incinerator West of Freon Warehouse

10 HCl Neutralization Pit
11 Sulfamic Acid Pits (2)
12 Antimony Pentachloride Settling Basin
13 Colloidal Silica Settling Pits (2)
14 Former Chrome Outfall and Impoundment
15 Former Wastewater Treatment System (Outfall 002)
16 Environmental Control System and Outfall 003 (Current Wastewater Treatment System)
17 Process Sewers
18 Sanitary Sewers
19 Building Maintenance Areas
20 I-90 Fill Area
21 Lead Arsenate Sludge Disposal Area
22 River Intake Canal

NOTES:
1) SWMUs 17 (process sewers) and 18 (sanitary sewers) are not shown on this figure, see Figure 3-7.
2) No locations are shown for SWMU 19. SWMU 19 includes a number of former accumulation areas for cleaning solvents, paints and waste oils. These accumulation areas were small, scattered around the plant, and too numerous to locate.
3) Based on information provided in the Phase I Groundwater Assessment Report (CH2M HILL 1990) and U.S. EPA guidance for corrective action.

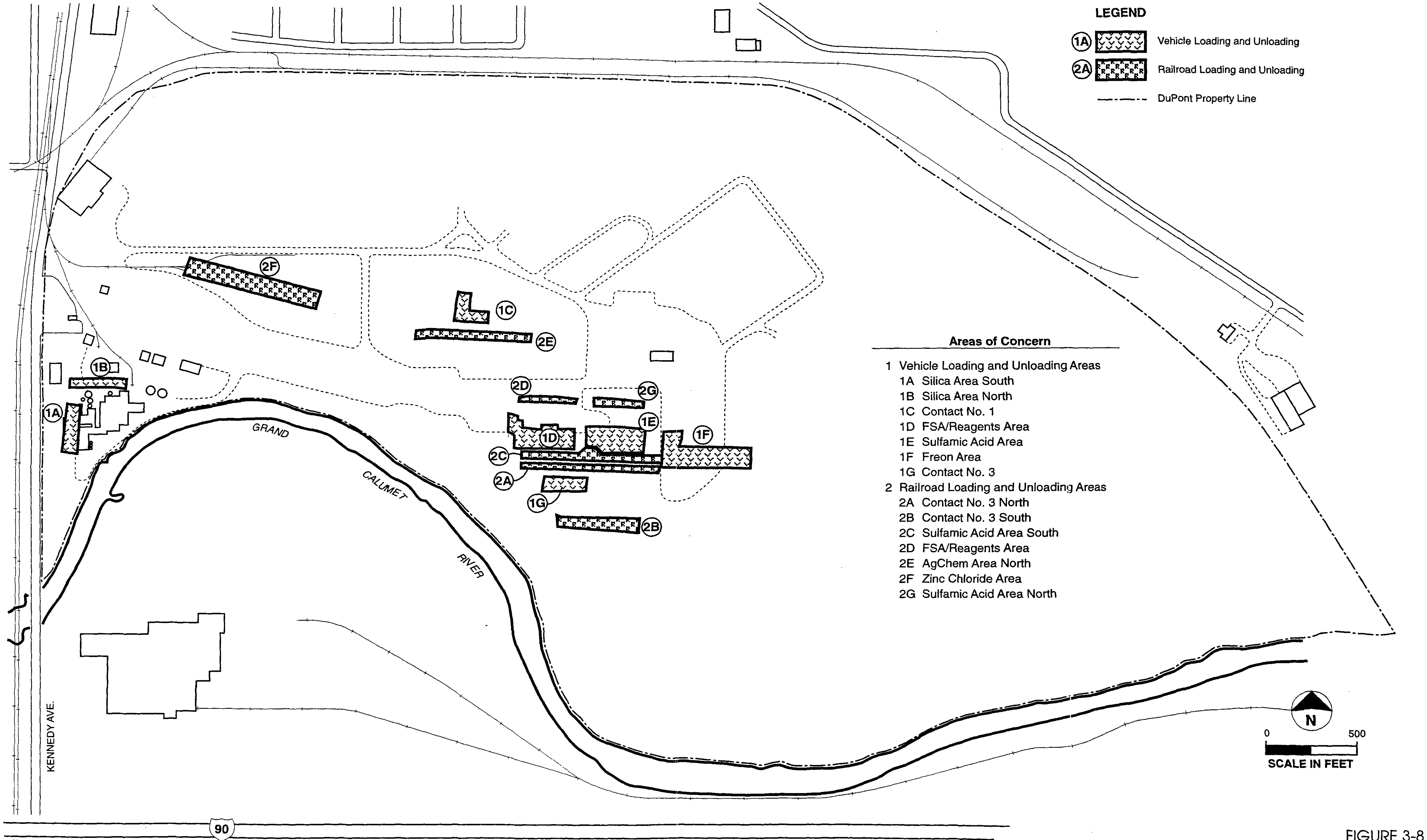
FIGURE 3-6
Solid Waste Management Units (SWMUs)
DuPont East Chicago Current Conditions Report
CH2MHILL

E142837.EC.CC Solid Waste Mgmt 10-21-97mms/tll



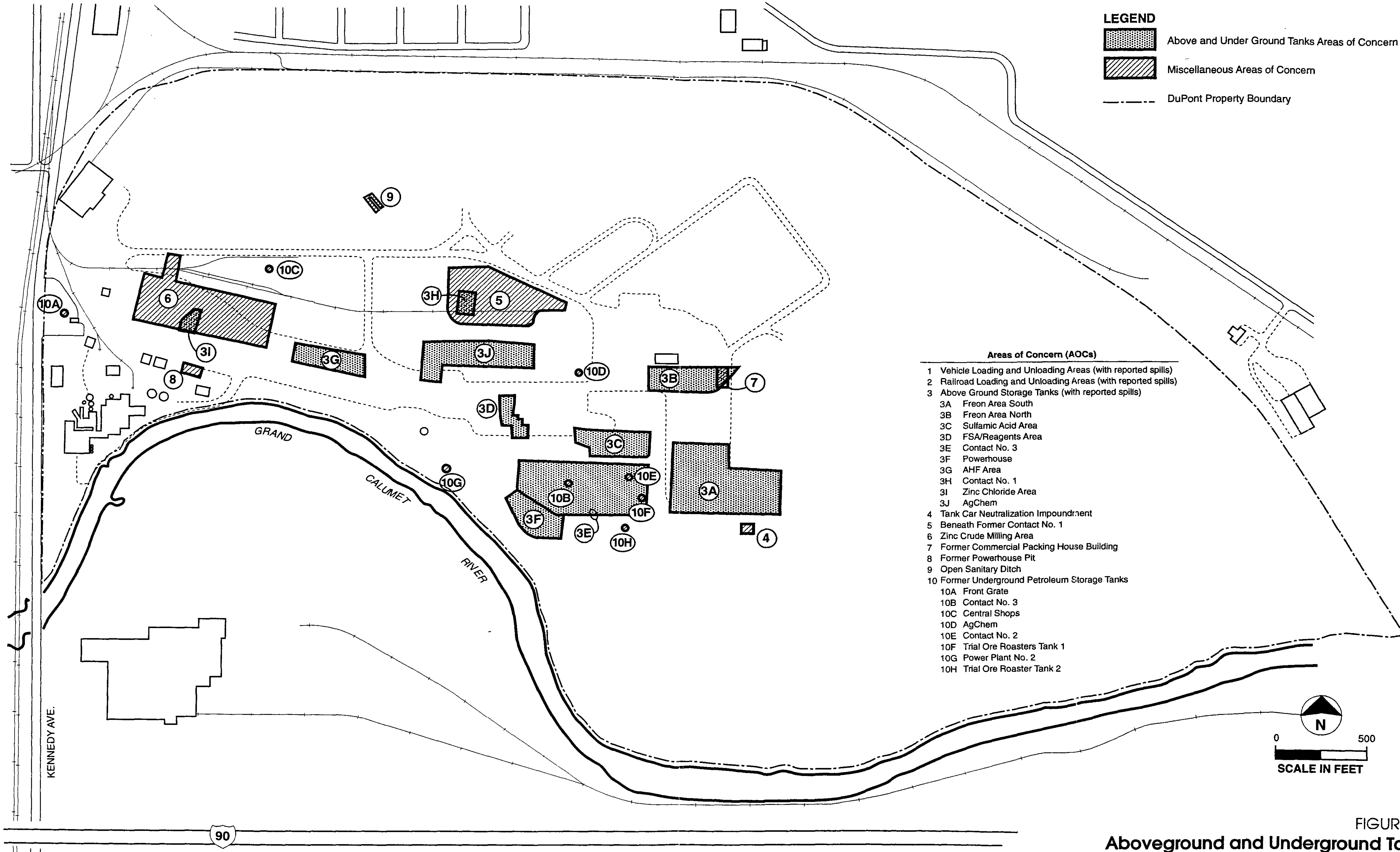
Source: CH2M HILL 1990 modified based on current plant knowledge

FIGURE 3-7
Process and Sanitary Sewer SWMUs
DuPont East Chicago Current Conditions Report
CH2MHILL



Source: CH2M HILL 1990 and U.S. EPA guidance for corrective action

FIGURE 3-8
Loading and Unloading Areas of Concern
DuPont East Chicago Current Conditions Report
CH2MHILL



Source: CH2M HILL 1990 and U.S. EPA guidance for corrective action

FIGURE 3-9
Aboveground and Underground Tanks and Miscellaneous Areas of Concern
DuPont East Chicago Current Conditions Report
CH2MHILL

CHAPTER 4

Current Understanding of Environmental Quality Conditions

This chapter presents DuPont's current understanding of environmental quality conditions at the East Chicago facility. It presents an overview of the investigative activities conducted at the facility, summarizes available quality data by medium and constituent or constituent groups (e.g., metals, volatile organic compounds), discusses data limitations, and describes the results of the characterization work completed to date. This information provides a basis for developing the site conceptual model.

Previous Facility Investigations

Testing Performed

Environmental studies conducted at the DuPont facility in the past are described briefly in Table 4-1. (A listing of U.S. EPA and IDEM contacts involved in these projects is contained in Volume 2.) DuPont performed most of these investigations, but some were performed by federal agencies such as U.S. EPA and U.S.G.S. Numerous investigations relating to the Grand Calumet System, conducted by state and federal agencies and other interested parties, are addressed under the Sediment Characterization Study and, therefore, are not presented herein.

The DuPont studies listed in Table 4-1 generated a fair amount of information about environmental quality conditions at the facility as a whole. These studies were not designed to answer specific questions regarding the presence or absence of releases at specific SWMUs or AOCs (identified in Chapter 3), or to determine the nature and extent of contamination at those units. Even so, the data are useful for general characterization of environmental conditions, such as magnitude of concentrations present in the media sampled or distribution across the facility where sampled. That information can be useful in developing a preliminary conceptual model of environmental quality conditions and in helping to guide future sampling and analysis work to be done under the RFI.

The earliest available data that are of use for this assessment were collected in 1983, when the U.S. EPA scored the site for ranking and possible inclusion on the Superfund National Priorities List. (The hazard ranking score assigned to the facility was too low to warrant further action under that program.) That sampling event, and all subsequent sampling activities at the facility, were conducted in accordance with project-specific sampling plans. Except for a study performed for property transfer purposes relative to the Conoco area, the resulting data can be used for characterization purposes under the RCRA Corrective Action Program. (The property transfer area study results are contained in Volume 2 and are not part of the assessment below.)

Data Availability and Data Quality

With the exception of screening data collected in 1992, all the DuPont and federal agency data sets were collected following quality assurance/quality control programs that generated the highest quality level (IV) data that can be used for any purpose (see Table 4-2). The screening level (III) data are sufficient for assessing the general magnitude of constituent concentrations present and the general boundaries of contamination. All the data may be used for preliminary risk evaluation purposes. (Available raw data or data summaries are contained in Volume 2.) Almost all the available data are for groundwater or soil samples.

A fair amount of information exists regarding groundwater quality within the developed part of the site. (That part of the site comprised the active and previously active manufacturing areas and the waste management areas outside the manufacturing areas.) The Phase I monitoring wells (installed in 1983 at the northern and southern edges of the facility) were sampled three times—once in 1983 and twice in 1990. The Phase II monitoring wells, located primarily around the perimeter of the developed part of the facility, were sampled twice in 1990. During Phase III (1992), grab samples were collected from the water table surface and the base of the Calumet Aquifer (roughly 25 feet below the water table surface) at about 180 locations spread across the developed part of the property. This groundwater data set is sufficient for preliminary assessment of facility conditions as a whole and for developing a preliminary conceptual model of these conditions.

The data set is insufficient for the purpose of assessing temporal or seasonal variations in groundwater quality and, more importantly, for determining the relationship between specific waste units or areas and groundwater conditions upgradient of, downgradient of, or at these units or areas. Although the SWMUs and AOCs identified in Chapter 3 could conceivably be potential sources of contamination, determinations of whether releases have occurred and whether contamination is present have yet to be performed. The sampling performed to date cannot be used to determine the nature and extent of contamination associated with SWMUs or AOCs. It is reasonable to assume that the data can be combined and used for the purpose of generally characterizing groundwater quality conditions at the facility as a whole.

Limited useful information exists regarding soil quality conditions at the site. The useful soil data are the results from the sampling and analysis of 2 surface soil samples, collected along the edge of the waterway in 1989, and about 55 subsurface samples, collected at roughly 180 locations within the developed portion of the facility in 1992. The 1992 samples were collected to characterize the quality of unsaturated native soil at the borings advanced for groundwater quality sampling purposes in Phase III. If unsaturated soil was not encountered, no solids samples were collected for analysis. Analytical data for unsaturated subsurface soil are available from roughly 30 percent of Phase III groundwater sampling locations. No information regarding surface soil environmental quality exists. Site-specific background concentrations have not been developed, and so direct comparisons between concentrations found and background levels cannot be made at this time.

The remainder of this chapter summarizes the constituents detected at the East Chicago facility by media, the frequencies of detection, and the concentrations across the East Chicago facility.

Constituents Detected

The constituents detected in the environmental media (Table 4-3) are generally consistent with DuPont's knowledge of chemical handling and management practices associated with historic and current operations at the facility, and with the relative abundance of constituents in the natural environment and potentially present in the fill (Table 4-4). This listing is based on site data generated during the studies described in Tables 4-1 and 4-2, without regard to whether the data were collected by DuPont, U.S.G.S., or the U.S. EPA.

Few organics were detected at more than a half dozen locations scattered across the facility (see Table 4-3). Inorganic constituents that are typical components of soil and groundwater in the natural environment (e.g., aluminum, calcium, carbonates, chloride, fluoride, iron, magnesium) and urban fill were found in abundance. Many are also primary components of products manufactured or trace elements in raw materials or waste handled at the site. With the exception of Freon, organic constituents were rarely detected in environmental media at the site.

Soil and Groundwater

This subsection summarizes the findings of DuPont's previous Phase I, II, and III soil and groundwater characterization work. It then relates those findings to constituent detection frequencies and ranges in concentrations observed in soil and groundwater that are listed in Table 4-2. Because it would be premature to attempt to focus this discussion on specific SWMUs or AOCs, given the data currently available for the plant, this presentation describes conditions at the plant as a whole, relying on information, such as the frequency of detection, the concentrations observed, the distribution of concentrations across the facility, and the general locations where upper-range concentrations were found. The soil and groundwater results are presented together (when both data types are available) to illustrate potential cross-media relationships.

For the purpose of this presentation, frequencies of detection (Table 4-5) and concentration statistics (Table 4-6) were compiled for the constituents detected in soil and groundwater grab samples and groundwater samples from monitoring and observation wells onsite. (Supplemental information is provided in Volume 2.) The relative abundance of a constituent at the site was indicated by its frequency of detection across the domain sampled, and its character was indicated by the mean, minimum, and maximum concentrations observed. Frequency and concentration information are illustrated together in Figure 4-1, where the number of dots shown indicates frequency of detection and the size of dots indicates relative concentrations found. General observations regarding the types of constituents detected, their abundance, and average concentrations are provided below.

Constituent Group Discussions

The discussion below focuses, first, on inorganic constituents and then on organic constituents detected onsite. Findings for constituents that were primary components of products manufactured at the facility, as identified in Chapter 3, are presented first, followed by those for constituents that were trace elements in products or waste streams. Results for sampling performed for other media (e.g., an abandoned sewer), along the channel bank, and or in sewers and sumps in Riley Park are provided in Volume 2.

Inorganics That Were Primary Components of DuPont Products

Chloride, Fluoride, Nitrate, Phosphate, and Sulfate

Chloride, fluoride, nitrate, phosphate, and sulfate were all handled at the facility (e.g., chloride in hydrochloric acid, fluoride in hydrofluoric acid, nitrate in nitric acid). The observed distributions of these constituents in groundwater were generally consistent with knowledge of historic chemical handling and management practices for these acids. (No soil data are currently available for these constituents). Two examples of these constituent distributions are provided for discussion purposes: the sulfate concentrations in groundwater (see Figure 4-2) and the chloride concentrations (see Figure 4-3). These two constituents were selected because they were handled over much of the primary manufacturing area and were ultimately managed and disposed of within the waste management areas in the northern and eastern parts of the developed area. (In these plots, the concentrations are represented by circles of varying darkness, illustrating the range of concentrations detected with lower value concentration represented by open dots and upper value concentrations represented by darker dots. A smaller dots mark the sampling location if the constituent was not detected at levels above the method detection limit. In all instances, the dots are centered over the location where the samples were collected.)

As expected, sulfate and chloride were found in varying concentrations across the plant. Of the sulfate concentrations detected, the upper-range sulfate concentrations (those greater than 1,500 mg/L) were detected (1) along the northern perimeter not far from the areas where materials containing sulfate were landfilled, (2) along the southern edge of the property, downgradient of the areas where sulfuric acid was manufactured (the sulfuric acid Chambers process area and sulfuric acid contact no. 3 area), (3) in the zinc oxide area, and (4) within the facility interior, downgradient of the sulfuric acid contact no. 1 area. (The manufacturing locations mentioned above are shown in Figure 3-4.) The upper values for chloride (those greater than 1,500 mg/L) were observed downgradient of the east end of the manufacturing area, where hydrochloric acid was handled and managed, and in the zinc chloride manufacturing area, where chloride was used as a raw material.

Arsenic, Barium, Chromium, Copper, Cyanide, Lead, and Zinc

Of the trace metals and inorganics that were primary components of products manufactured at the facility, only arsenic, barium, chromium, lead, and zinc were detected in sufficient frequency (greater than or equal to 20 percent of the samples tested) to warrant detailed review of their distribution in site soil and groundwater.

Arsenic was detected in a little more than half of the soil and groundwater samples collected from the base of the aquifer and in about one-quarter of the groundwater samples collected from the top of the aquifer. What is currently known regarding arsenic concentrations in soil is illustrated in Figure 4-4a. The distribution of arsenic in groundwater (Figures 4-4b and 4-4c) differed considerably from that in soil. Correlations between upper-range concentrations in soil and in groundwater were found in some areas but not in others. Upper-range arsenic concentrations (greater than 1.5 mg/L) were found at the water table near the AgChem and insecticide area, parts of the ash/stoker grate ash and calcium sulfate/TSP areas, and the western part of the zinc chloride area. The upper value concentrations at the base of the aquifer were found at similar but not exactly the same locations as those found at the water table surface. Upper-range concentrations at the aquifer base were found over larger areas, particularly west and south of the AgChem and insecticide areas (near Power Plant No. 2), and within and southeast of the Freon area. The presence of arsenic at and downgradient of the AgChem and insecticide areas is reasonable given that arsenic-based products had been made in those areas.

Barium was detected in almost all soils, most of the groundwater from the base of the aquifer, and less than half the groundwater from the top of the aquifer. The observed distribution could not be readily related to areas known to handle barium. The reason for the greater prevalence at the base of the aquifer is not known.

Chromium was found in just under three-quarters of the soil samples and roughly one-quarter of the groundwater samples collected. Except in the Conoco area, a relationship between the chromium concentrations in soil and in groundwater is not apparent upon inspection of the chromium distributions. Chromium concentrations detected in groundwater are relatively low compared to the other primary component constituents. The distribution of detectable levels of chromium in groundwater at the base of the aquifer was similar to that observed at the top of the aquifer.

Lead was somewhat prevalent in soil and less prevalent in groundwater. Upper-range concentrations in the soil were observed in the Conoco area, the western part of the zinc chloride area, the Chambers process area, southwest of the AgChem area, the phosphoric acid/sulfuric acid Contact No 1 areas, and the Freon area (Figure 4-5a). Upper-range concentrations of lead (greater than 1.5 mg/L) in the upper and lower parts of the aquifer (Figures 4-5b and 4-5c) were not consistent with those observed in soil. Upper-range concentrations in groundwater were more prevalent at the water table surface than at the aquifer base. At the water table, the upper-range concentrations appeared to be associated with some of the areas where lead is present in soil (e.g., the Conoco area) and where acids were handled (e.g., near the zinc oxide area, the phosphoric acid area/Contact No. 1 area, and the Sulfuric Acid Contact No. 3/zinc roasters area). With the exception of the distribution found in the ash and calcium sulfate/TSP areas, lead in the groundwater at the base of the aquifer was found as isolated occurrences (at the northeast edge of the chloride area and in the sulfamic acid area; see Figure 4-5c).

Zinc was detected in all the soil samples and in 85 to 90 percent of the groundwater samples at the site. The distributions in soil, groundwater at the top of the aquifer, and groundwater at the base of the aquifer are illustrated in Figures 4-6a, 4-6b, and 4-6c. In general, the locations of upper-range zinc concentrations in soil and groundwater were found to be near areas that routinely handled zinc materials, such as the zinc chloride, zinc oxide, and zinc roaster areas. Several areas were also locations where acids were manufactured or handled. Zinc was found to be widely distributed in groundwater at the water table and more narrowly distributed in the groundwater at the base of the aquifer. The locations with the upper-range concentrations (greater than 100 mg/L) at the base of the aquifer differ from those detected above (Figures 4-6b and 4-6c). Zinc concentrations at the base are highest at the eastern end of the zinc chloride area (towards the Chambers Process area), in the Contact No. 1 area, and in the zinc roasters area.

Inorganics That Were Trace Constituents in Facility Waste Streams

The frequencies of detection, concentrations, and concentration distributions of antimony, boron, cadmium, nickel, and vanadium were reviewed as part of the current conditions assessment (see Tables 4-5 and 4-6 and Figure 4-1). Boron was found to be most prevalent in groundwater (maximum detection frequency of detection of 95 percent; followed by vanadium (60 percent); nickel (45 percent); cadmium (30 percent); and antimony (25 percent). Vanadium and nickel are more prevalent at depth within the aquifer, while little difference was observed in the detection frequencies for antimony, and cadmium between the top and base of the aquifer.

Distribution plots for these constituents are contained in Volume 2. In general, few similarities exist between the observed distributions in soil and in groundwater at the facility. With the exception of antimony, clear relationships between groundwater quality at the top of the aquifer and at the base of the aquifer were not found upon inspection of the distribution plots for these constituents.

Inorganics Summary

The upper-range concentrations of metals in soil and groundwater overlap in distribution. Higher concentrations of metals are clustered within several consistent areas across the site. The common areas tend to have documented acid spills or are areas where acids were manufactured or stored. Some metals were detected in the areas where they were used in the manufacturing processes (e.g., zinc in the zinc chloride area, arsenic in the AgChem and insecticides areas) and where ash, sinters, or sludges containing metals were disposed of onsite. (Additional distribution plots are provided in Volume 2).

Clear and simple relationships between soil, groundwater at the top of the aquifer, and groundwater at the base of the aquifer were rarely apparent. Upper-range concentrations in soil often were not found to correlate with upper-range concentrations in groundwater at the water table surface. Sometimes the concentrations in groundwater at the aquifer base resembled the distributions in soil better than those in groundwater at the water table surface. These findings suggest the potential presence of multiple sources, multiple processes affecting constituent fate and transport, and varied operation area histories.

Organic Constituents

Organic constituents were generally not found in samples from soil or groundwater at the East Chicago facility. The exceptions (listed in Tables 4-3 through 4-6) were rarely detected at more than six sampling locations. Of the exceptions, Freon, carbon tetrachloride, and toluene were either produced or raw materials used at the facility. Freon was detected in roughly 10 percent of the soil samples and just under 15 percent of the groundwater samples collected. The mean concentrations for Freon were roughly 40 µg/kg in soil, 50 µg/L in groundwater at the top of the aquifer, and 70 µg/L in groundwater at the base of the aquifer. Freon detection locations are in, south of, or southeast of the Freon area (Figures 4-7a and 4-7b). The locations where organics other than Freon were found in groundwater or soil are distributed across the facility and do not appear to be correlated with an identified area. These locations and the concentrations observed by constituent are provided in Volume 2.

The most prevalent of the organics detected were carbon disulfide (at about 60 percent of the samples tested) and chloroform (at about 20 percent). The distribution of carbon disulfide cannot be directly related to past waste or materials handling practices. Carbon disulfide is known to be a common, naturally-occurring organic compound associated with natural organic soils such as peat or lacustrine soils that are swampy or under reducing conditions (Taylor et al. 1982). Chemical and geologic data collected during this study and by others (U.S.G.S. 1982; USDA 1972) indicate that these conditions exist within the Calumet Sand in areas at the DuPont property. Carbon disulfide is often used as an indicator of microbial activity. The highest concentration of carbon disulfide (193 µg/L) was discovered in a swampy area at MW-8. This information supports the conclusion that carbon disulfide may be naturally occurring and not related to DuPont chemical management practices. Chloroform, a common laboratory contaminant, was detected inconsistently in samples from monitoring wells in the Freon area during Phase II and in grab samples collected during Phase III.

Grand Calumet System Media

Assessments of conditions in the surface water, riparian soil, and sediment along and within the East Branch of the Grand Calumet System will not be addressed in the RCRA Corrective Action work for the facility. Instead, the quality of environmental media within the 100-year floodplain will be addressed under DuPont's Sediment Characterization effort. (See the Sediment Characterization Study Work Plan (PTI 1997)).

Air

No evidence exists of air discharges associated with SWMUs or AOCs. Given available information regarding these units and areas, any emissions would be expected to be minor. Available soil and groundwater data suggest that the probability of volatile organic emissions is low.

Subsurface Gas

No evidence exists of subsurface discharges associated with SWMUs or AOCs. Although it is conceivable that subsurface gas is present in abandoned sanitary or process sewers, the amount of gas released is expected to be small.

TABLE 4-1
Previous East Chicago Facility Investigations
(Page 1 of 2)

Date[a]	Party	Purpose	Findings
1983	U.S. EPA	Test groundwater quality at north and south edges of facility, rank site for potential inclusion on National Priorities List (NPL)	Inorganics present; few organics detected Ranked too low to be included on NPL
1983	DuPont	Collected groundwater samples from the U.S. EPA wells at the time of their sampling by U.S. EPA	Inorganics present; few organics detected
1987–1988	U.S.G.S.	Summarize regional geohydrology and general water quality of the Calumet aquifer Identify recharge and discharge sources and estimate the quantity and quality of the groundwater being discharged to the surface water bodies Compare data from wells in the land use group to data from "contaminated" sites and data from "natural" areas Assess potential for contamination of surface water by groundwater	Aquifer-stream interactions on the Grand Calumet System/Indiana Harbor Canal are directly related to Lake Michigan water levels Fluctuations in lake levels, evapotranspiration, and precipitation cause local reversals in groundwater gradients near the stream Sewers are the largest groundwater sinks Water from the commercial, steel, and petrochemical land use groups had higher median concentrations than water from the "natural" areas but lower median concentrations than water from the "contaminated" sites
1989	DuPont	Collect two surface soil samples at the channel's edge to assess soil quality in area containing dead vegetation	Soil found to contain a variety of constituents, including toluene and hexazinone and other constituents
1990	DuPont (CH2M HILL) [Phase II]	Assess site hydrogeology and groundwater quality primarily along plant perimeter Determine potential for constituent offsite migration and assess potential impact on a preliminary basis Perform survey fir wells north of property Sample and analyze Riley Park sewers and sumps	Groundwater divide discovered with groundwater migrating to the north and to the river south of plant Inorganics detected; few organics found in groundwater Estimated loading from groundwater to surface water found to be less than 1 percent of the total mass for most constituents Surface water quality without groundwater discharge from DuPont is indistinguishable from surface water quality with contributions from DuPont No groundwater is used by the residential neighborhood immediately to the north Constituent concentrations in sewers decrease with increased distance from plant

TABLE 4-1
Previous East Chicago Facility Investigations
(Page 2 of 2)

Date[a]	Party	Purpose	Findings
1991–1992	DuPont (CH2M HILL) [Sec 308 work]	Monitor water quality at three sites along the Grand Calumet channel	Intermittent flow from springs at channel bank Water quality is similar to groundwater quality at nearby monitoring wells
1991	DuPont	Test quality of water and sediment in abandoned sewer	Water found to be more like surface water in quality than groundwater; water found to contain insecticides manufactured at the plant
1992	DuPont [Phase III]	Obtain data on the chemical quality of the groundwater and hydrogeologic characteristics of the aquifer to support design of a groundwater remediation system (if warranted) – Characterize lithology – Conduct groundwater and soil sampling – Perform aquifer property testing	Better characterization of aquifer material and aquifer properties Metals and selected organic data for 348 groundwater samples collected from 180 locations (179 from the top of the aquifer, 168 from the base of the aquifer) and 55 soil samples were collected

[a]Date sampling was performed.

Notes:
1. An environmental assessment associated with the transfer of the Conoco area back to DuPont control was performed in 1990. Due to the quality of the data generated, this study is not included in the list above or in this current conditions report.
2. The studies listed above are those that generated environmental quality data for the facility. Additional studies generating information on the plant, Calumet aquifer hydraulic conditions, or habitat are listed in the references. Much of the pertinent physical condition information is provided in Volume 2 of this report.

TABLE 4-2
Available Environmental Quality Data at the DuPont East Chicago Facility

Date	Party	Media	Constituent Group: Major Inorganic Ions and Water Quality Indicators[a]	Common Metals[b]	Trace Metals/ Inorganics[c]	Volatile Organic Compounds	Semivolatile Organic Compounds	PCBs	Pesticides	Data Quality Level[d]
1983	U.S. EPA	Groundwater		X	X	X	X	X	X	IV
1983	DuPont	Groundwater	X	X	X	X	X	X	X	
1987	U.S.G.S.	Groundwater	X	X	X	X	X			IV
1988	U.S.G.S.	Groundwater	X	X	X	X	X			IV
1989	DuPont	Soil	X	X	X	X	X	X		IV
1990	DuPont (CH2M HILL) [Phase II]	Groundwater	X	X	X	X	X	X		IV
		Surface Water	X	X	X	X	X			IV
1991	DuPont (CH2M HILL) [Section 308]	Shallow Groundwater	X	X	X	X	X	X	X	IV
1991	DuPont (CH2M HILL)	Sewer Water	X	X	X				X[g]	IV
		Sewer Sediment							X[g]	IV
1992	DuPont (DERS) [Phase III]	Groundwater[e]	X	X	X	X				III
		Soil	X	X	X	X				III
1992	DuPont (DERS) [Phase III]	Groundwater[f]	X	X	X	X				III

[a]Major ions are those that are prevalent in the environment—primary components in rock, soil, and water (e.g., calcium, magnesium, sodium).
[b]Common metals are those that are abundant in rock, soil, and water at concentrations in the ppm range.
[c]Trace metals are those that are not abundant in rock, soil, and water and when detected are present in concentrations in the ppb range.
[d]Data quality levels range from I to V. Level III data are an intermediate level of data quality used for site characterization, while Level IV provide the highest level of data quality appropriate for comprehensive risk and nature and extent assessments.
[e]Sampling over large portion of plant.
[f]Sampling at three locations associated with aquifer property testing.
[g]Analyzed for five pesticides (e.g., fenuron, linuron, siduron, hexazinone and diuron.)
DERS = DuPont Environmental Remediation Services
For specific analytes in constituent groups marked with footnotes a, b, and c, refer to Table 4-4.

TABLE 4-3
Summary of Constituents Detected at the DuPont East Chicago Facility

Major Inorganic Ions and Water Quality Parameters	Common Metals	Trace Metals or Inorganics	Volatile Organic Compounds
Calcium	Aluminum	Antimony	1,1,1-Trichloroethane*
Carbonates	Iron	Arsenic	1,1-Dichloroethane*
Chloride	Manganese	Barium	Bromodichloromethane**
Fluoride		Boron	Carbon disulfide
Nitrogen Compounds		Cadmium	Chloroform
(Nitrates, Ammonia)		Chromium	Dibromochloromethane**
Magnesium		Copper	Methylene chloride**
Phosphate		Cyanide*	Trichlorofluoromethane (Freon)*
Potassium		Lead	
Silica		Mercury**	
Sodium		Nickel	
Sulfate		Selenium	
		Silver	
		Vanadium	
		Zinc	

Notes:
Other constituents were detected but are not listed above for one of the following reasons:

- Frequency of detection was low (< 5%) (e.g., carbon tetrachloride, phenol, bis(2-ethylhexyl) phthalate).
- Fewer than six samples were tested for the specific constituent (e.g., tin, beryllium, cobalt, thallium, hexazinone).
- Results were not reproducible or were suspect given knowledge of facility operations.

Data are also available for other parameters but not listed above (e.g., alkalinity, total dissolved solids, total suspended solids, chemical oxygen demand, hardness).

*Detected in less than 15 percent of samples.
**Detected in less than 10 percent of samples.

TABLE 4-4

Materials Containing Constituents Detected[a] at the DuPont East Chicago Facility

	Present in Natural Environment[b]	Present in Urban Fill[c]	Component of Product or Waste Stream	
			Primary	Trace
Major Inorganics, Common Metals, and Water Quality Parameters				
Aluminum	X (A)	X	X	
Calcium	X (A)		X	
Carbonates	X (A)		X	
Chloride	X (A)	X	X	
Fluoride	X (LA)	X	X	
Iron	X (A)	X	X	
Magnesium	X (A)	X		
Manganese	X (LA)	X		
Nitrogen, total	X (LA)		X	
Phosphate	X (LA)		X	
Potassium	X (LA)			
Silica	X (A)		X	
Sodium	X (A)	X	X	
Sulfate	X (LA)	X	X	
Trace Inorganics/Metals				
Antimony		X		X
Arsenic		X		X
Barium		X	X	
Boron		X		X
Cadmium		X		X
Chromium		X		X
Copper		X	X	
Cyanide		X	X	
Lead		X	X	
Mercury		X		
Nickel		X		X
Selenium		X		X
Silver				X
Vanadium		X		X
Zinc		X	X	
Organics[d]				
1,1,1-Trichloroethane				
1,1-Dichloroethane				
Bromodichloromethane				
Carbon disulfide				
Chloroform				
Dibromochloromethane				
Methylene chloride				
Toluene			X	
Trichlorofluoromethane (Freon)			X	

Notes:

[a]Other constituents were detected but are not listed above for one of the following reasons:

- Frequency of detection was low (< 5%).
- Fewer than six samples were tested for the specific constituent.
- Results were not reproducible or were suspect given knowledge of plant operations.

[b]Data from Dragun (1988).

[c]CH2M HILL inhouse information.

[d]Only three SVOCs were detected (at no more than four locations): PCP, Phenolics, and Total Phenols.

A = Abundant, concentrations in the % range in soil or rock, ppm range in water.

LA = Less abundant, concentrations in the lower ppm range in soil and water.

TABLE 4-5
Summary of Constituent Frequency by Medium
(Page 1 of 3)

Constituent	Soil			Groundwater at Top of Aquifer			Groundwater at Base of Aquifer		
	No. of Detects	No. of Samples	Percent Detected	No. of Detects	No. of Samples	Percent Detected	No. of Detects	No. of Samples	Percent Detected
Major Inorganic and Water Quality Indicators									
Alkalinity				3	3	100	40	45	89
Calcium	53	57	93	181	184	98	197	198	99
Chloride				3	3	100	45	45	100
COD							20	20	100
Fluoride							25	25	100
Hardness (as $CaCO_3$)							5	5	100
Magnesium	49	57	86	182	184	99	196	198	99
Nitrogen compounds				2	2	100	58	60	97
Oxygen (dissolved)				3	4	75			
Phosphate							31	36	86
Potassium							25	25	100
Silica							5	5	100
Sodium							25	25	100
Sulfate							45	45	100
Sulfide	2	2	100						
Total dissolved solids (TDS)							45	45	100
Total suspended solids							5	5	100
Temperature				4	4	100	5	5	100
pH				6	6	100	43	43	100
Common Metals									
Aluminum	55	63	87	93	192	48	88	227	39
Iron	55	57	96	168	184	91	194	201	97
Manganese							27	28	96
Trace Organics/Inorganics									
Antimony	29	65	45	38	193	20	55	224	25
Arsenic	39	65	60	51	193	26	134	232	58
Barium	59	65	91	84	192	44	147	226	65
Beryllium	2	2	100				0	3	0
Boron							37	42	88
Cadmium	40	65	62	57	192	30	47	225	21

TABLE 4-5
Summary of Constituent Frequency by Medium
(Page 2 of 3)

Constituent	Soil			Groundwater at Top of Aquifer			Groundwater at Base of Aquifer		
	No. of Detects	No. of Samples	Percent Detected	No. of Detects	No. of Samples	Percent Detected	No. of Detects	No. of Samples	Percent Detected
Chromium (Total)	44	65	68	43	192	22	69	226	31
Chromium (Hexavalent)							0	34	0
Cobalt	1	2	50				0	3	0
Copper	2	2	100				5	42	12
Cyanide							5	42	12
Lead	48	65	74	52	192	27	38	226	17
Mercury	2	3	67				1	40	3
Nickel	39	65	60	49	193	25	95	222	43
Selenium	2	2	100				1	6	17
Silver	2	2	100				0	6	0
Thallium	2	2	100				0	3	0
Tin	1	2	50				0	3	0
Vanadium	28	65	43	90	191	47	111	182	61
Zinc	65	65	100	168	191	88	200	231	87
Volatile Organic Compounds									
1,1,1-Trichloroethane	0	4	0	5	14	36	5	59	8
1,1,2-Trichloroethane	0	25	0	0	116	0	1	157	1
1,1-Dichloroethane	0	4	0	3	14	21	5	57	9
1,2-Dichloroethane	0	25	0	3	115	3	1	126	1
1,2-Dichloroethene	0	2	0	0	13	0	2	51	4
Benzene	0	25	0	1	117	1	1	160	1
Bromodichloromethane	0	4	0	0	13	0	6	53	11
Carbon disulfide	0	2	0				25	43	58
Carbon tetrachloride	1	25	4	4	117	3	0	157	0
Chloroform	0	4	0	2	15	13	13	60	22
Dibromochloromethane	0	4	0	0	13	0	4	53	8
Dichlorodifluoromethane	0	2	0	1	2	50	0	3	0
Ethylbenzene	0	25	0	1	117	1	0	157	0
Methylene chloride	0	4	0	0	14	0	6	57	11
Styrene	0	2	0	1	2	50	0	39	0
Tetrachloroethene	0	25	0	2	117	2	0	160	0

TABLE 4-5
Summary of Constituent Frequency by Medium

Constituent	Soil			Groundwater at Top of Aquifer			Groundwater at Base of Aquifer		
	No. of Detects	No. of Samples	Percent Detected	No. of Detects	No. of Samples	Percent Detected	No. of Detects	No. of Samples	Percent Detected
Toluene	3	25	12	2	117	2	3	158	2
Trichloroethene	1	25	4	3	117	3	0	160	0
Trichlorofluoromethane	3	25	12	19	119	16	15	123	12
Xylene (total)	0	23	0	1	105	1	0	139	0
Semivolatile Organic Compounds									
Bis(2-ethylhexy)phthalate (BEHP)	0	2	0	1	3	33	1	40	3
Di-n-octyl phthalate	0	2	0	0	3	0	2	40	5
PCP	0	2	0	0	3	0	4	40	10
Phenol	0	2	0	0	3	0	2	37	5
Phenoloics							1	3	33
Total Phenols				3	3	100	0	6	0
Pesticides									
Hexazinone	2	2	100						
PCBs									
Aroclor 1242	2	2	100				0	6	0

Note:
Only compounds detected above the MDL have been included in this table. Refer to the Phase III Groundwater report for a complete listing of analyzed compounds.

TABLE 4-6
Summary of Constituent Concentrations by Media
(Page 1 of 3)

Constituent	Soil				Groundwater at Top of Aquifer				Groundwater at Base of Aquifer			
	Mean[a]	Minimum[b]	Maximum[c]	No. of Samples	Mean[a]	Minimum[b]	Maximum[c]	No. of Samples	Mean[a]	Minimum[b]	Maximum[c]	No. of Samples
Major Inorganic Ions and Water Quality Indicators	mg/kg	mg/kg	mg/kg		mg/L	mg/L	mg/L		mg/L	mg/L	mg/L	
Alkalinity					839	187	2100	3	608	4.0	7,000	45
Calcium	8,788	12.5	91,434	57	425	1.0	2,059	184	1,228	0.19	11,209	198
Chloride					108	13.0	180	3	1,213	18.0	18,000	45
COD					1063	393	1780	4	4,568	3480	5500	5
Fluoride									5.7	0.40	17.0	25
Hardness (as $CaCO_3$)									1,583	1,200	2,000	5
Magnesium	1,041	1.25	10,000	57	45	0.10	842	184	547	0.04	9,479	198
Nitrogen Compounds					0.235	0.15	0.31	2	14.2	0.05	99	60
Oxygen (dissolved)					0.64	0.10	1.20	4				
Phosphate									3.1	0.03	24	36
Potassium									14.4	3.1	45	25
Silica									38	16.0	50	5
Sodium									423	15.7	3,600	25
Sulfate									1,634	80	7,030	45
Sulfide	6	4	8	2								
Total dissolved solids (TDS)									5,051	783	30,600	45
Total suspended solids (TSS)									116	30	200	5
Temperature (ºC)					12.9	9.5	19	4	16.7	12.3	19.7	5
pH					6.9	6.0	8.0	6	7.0	5.4	11.6	43
Common Metals	mg/kg	mg/kg	mg/kg		mg/L	mg/L	mg/L		mg/L	mg/L	mg/L	
Aluminum	1,611	0.63	17,490	63	15.2	0.05	1,387	192	4.4	0.01	149	227
Iron	9,387	1.25	84,765	57	100	0.10	10,462	184	347	0.10	24,654	201
Manganese									1.60	0.01	6.55	28
Trace Metals/Inorganics	mg/kg	mg/kg	mg/kg		mg/L	mg/L	mg/L		mg/L	mg/L	mg/L	
Antimony	53	3.0	451	65	1.16	0.12	11.4	193	1.35	0.006	20	224
Arsenic	90	0.46	1,607	65	0.36	0.005	8.8	193	1.37	0.001	32	232
Barium	104	0.125	1,600	65	0.50	0.01	81	192	0.24	0.01	100	226
Beryllium	1.3	1.0	1.6	2					2.5[d]	5	5	3

TABLE 4-6
Summary of Constituent Concentrations by Media
(Page 2 of 3)

Constituent	Soil				Groundwater at Top of Aquifer				Groundwater at Base of Aquifer			
	Mean[a]	Minimum[b]	Maximum[c]	No. of Samples	Mean[a]	Minimum[b]	Maximum[c]	No. of Samples	Mean[a]	Minimum[b]	Maximum[c]	No. of Samples
Boron									1.05	0.15	10.9	42
Cadmium	23	0.17	380	65	0.19	0.02	6.1	192	0.14	0.001	7.0	225
Chromium (Total)	22	0.21	430	65	0.06	0.04	0.47	192	0.12	0.005	20	226
Chromium (Hexavalent)									0.01[d]	0.01	0.30	34
Cobalt	3.3	2.0	5.5	2					25[d]	50	50	3
Copper	370	330	410	2					1.40	0.01	50	42
Cyanide	1.95	1.60	2.3	2					0.11	0.001	5	40
Lead	1,384	0.125	22,660	65	0.44	0.01	14.0	192	0.64	0.01	200	226
Mercury	0.72	0.13	1.30	3					0.009	0.0001	0.30	40
Nickel	12.0	0.62	117	65	0.09	0.05	1.20	193	0.37	0.01	40	222
Selenium	1.20	1.10	1.30	2					9.3	2.0	43	6
Silver	3.0	2.8	3.1	2					3.5	0.01	10.0	6
Thallium	0.40	0.30	0.50	2					5.0[d]	10.0	10.0	3
Tin	125	100	200	2					10.0[d]	20	20	3
Vanadium	4.7	0.125	54	65	0.03	0.005	1.47	191	1.97	0.01	200	182
Zinc	4.7	0.13	54	65					27	0.005	1,739	231
Volatile Organic Compounds[e]	µg/kg	µg/kg	µg/kg		µg/L	µg/L	µg/L		µg/L	µg/L	µg/L	
1,1,1-Trichloroethane	2.25[d]	3.9	5	4	4.0	0.20	13.0	14	1.82	1.00	16.0	59
1,1,2-Trichloroethane	11.2	3.9	25	25	11.7	0.20	25	116	10.3	1.00	26	157
1,1-Dichloroethane	2.3[d]	3.9	5.0	4	2.9	0.20	11.0	14	2.1	1.00	10.0	57
1,2-Dichloroethane	11.2	3.9	25	25	26	5.0	1,400	115	12.0	5.0	160	126
1,2-Dichloroethene	2.5[d]	5.0	5.0	2	2.1	0.20	5.0	13	2.6	1.00	45	51
Benzene	11.2	3.9	25	25	12.2	0.20	62	117	10.2	1.00	25	160
Bromodichloromethane	2.3[d]	3.9	5.0	4	2.1	0.20	5.0	13	1.65	1.00	5.0	53
Carbon disulfide	4.0[d]	7.8	8.2	2					21	1.00	193	43
Carbon tetrachloride	32	3.9	483	25	21	0.20	792	117	10.2	1.00	25	157
Chloroform	2.3[d]	3.9	5.0	4	29	0.20	350	15	63	1.00	1,300	60
Dibromochloromethane	2.3[d]	3.9	5.0	4	2.1	0.20	5.0	13	1.49	1.00	5.0	53
Dichlorodifluoromethane	40[d]	78	82	2	2.1	0.20	4.2	2	5.0[d]	10.0	10.0	3
Ethylbenzene	11.2	3.9	25	25	11.7	0.20	25	117	10.2	1.00	25	157

TABLE 4-6
Summary of Constituent Concentrations by Media
(Page 3 of 3)

Constituent	Soil				Groundwater at Top of Aquifer				Groundwater at Base of Aquifer			
	Mean[a]	Minimum[b]	Maximum[c]	No. of Samples	Mean[a]	Minimum[b]	Maximum[c]	No. of Samples	Mean[a]	Minimum[b]	Maximum[c]	No. of Samples
Methylene chloride	3.3[d]	5.0	8.2	4	2.1	0.20	5.0	14	21	5.0	520	57
Styrene	2.0[d]	3.9	4.1	2	0.15[d]	0.20	0.20	2	0.61[d]	1.00	5.0	39
Tetrachloroethene	11.2	3.9	25	25	11.8	0.20	25	117	10.2	1.00	25	160
Toluene	18.2	3.9	105	25	12.2	0.20	65	117	10.2	1.00	25	158
Trichloroethene	29	3.9	416	25	30	0.20	1,952	117	10.2	1.00	25	160
Trichlorofluoromethane	41	3.9	394	25	48	0.20	2,100	119	68	5.0	4,300	123
Xylene (total)	11.6	3.9	25	23	12.3	0.20	25	105	10.7	1.00	25	139
Semivolatile Organic Compounds[e]	mg/kg	mg/kg	mg/kg		μg/L	μg/L	μg/L		μg/L	μg/L	μg/L	
Bis(2-ethylhexyl)phthalate (BEHP)	30[d]	33	88	2	4.7[d]	5.0	9.0	3	5.5[d]	10.0	20	40
Di-n-octyl phthalate	30[d]	33	88	2	5.0[d]	10.0	10.0	3	6.7[d]	10.0	100	40
PCP	153[d]	170	440	2	15.0[d]	30	30	3	48	25	1320	40
Phenol	30[d]	33	88	2	2.5[d]	5.0	5.0	3	12.7	10.0	208	37
Phenolics									34[d]	50	51	3
Total phenols					0.007	0.004	0.009	3	0.005[d]	0.005	0.025	6
Pesticides	μg/g	μg/g	μg/g									
Hexazinone	0.26	0.19	0.34	2								
PCBs	μg/kg	μg/kg	μg/kg						μg/L	μg/L	μg/L	μg/L
Aroclor 1242	10,000	9,000	11,000	2					0.275[d]	0.10	1.00	6

[a]Mean concentrations were calculated using the following estimations:
- Multiple detections at each location were, themselves, averaged before calculating mean.
- Nondetects were included in the calculation by assuming a value of one-half of the MDL.

[b]The minimum concentration is either the lowest detected value or the lowest MDL for that constituent.
[c]The maximum concentration is either the highest detected value or the highest MDL for that constituent.
[d]Computed mean listed is below the MDL. The mean is artificially low because of the computation method (which includes one-half MDL for nondetects).
[e]Only detected constituents are listed.

The total number of dots shown indicates the frequency of constituent detections. A solid dot should be counted as 10% and an open dot should be counted as 5%. For example, ●●○ would be read "detected at a frequency of 25%."

The size of the dots reflects the average concentration based on the following scale:

● 0–0.1 ● 0.1–1.0 ● 1–10 ● 10–50 ● 50–100 ● 100–1,000

Concentrations of inorganic constituents are in mg/kg and mg/L, and concentrations for organic constituents are in µg/kg and µg/L.

Constituent Groups and Constituents	Media		
	Soil	Groundwater—Top of Aquifer	Groundwater—Base of Aquifer
Common Metals and Inorganics (●'s in ppm)			
Aluminum	●●●●●●●●○	●●●●●	●●●●
Calcium	●●●●●●●●●○	●●●●●●●●●●	●●●●●●●●●●
Chloride		●●●●●●●●●●	●●●●●●●●●●
Iron	●●●●●●●●●○	●●●●●●●●●	●●●●●●●●●○
Magnesium	●●●●●●●●○	●●●●●●●●●●	●●●●●●●●●●
Manganese			●●●●●●●●●●○
Potassium			●●●●●●●●●●
Sodium			●●●●●●●●●●
Fluoride			●●●●●●●●●●
Phosphate			●●●●●●●●●●

FIGURE 4-1 (SHEET 1 OF 3)

Constituent Frequency and Relative Magnitude Detected by Media

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Constituent Groups and Constituents	Media		
	Soil	Groundwater—Top of Aquifer	Groundwater—Base of Aquifer
Nitrogen compounds			●●●●●●●●●●
Sulfate			●●●●●●●●●●
Trace Metals and Inorganics (●'s in ppm)			
Antimony	●●●●○	●●	●●○
Arsenic	●●●●●●	●●○	●●●●●○
Barium	●●●●●●●●●	●●●●○	●●●●●●○
Boron			●●●●●●●●●
Cadmium	●●●●●●	●●●	●●
Chromium	●●●●●●●	●●	●●●
Copper			●
Cyanide			●
Lead	●●●●●●●○	●●○	●○
Nickel	●●●●●●	●●○	●●●●○
Vanadium	●●●●○	●●●●○	●●●●●●
Zinc	●●●●●●●●●●	●●●●●●●●●	●●●●●●●●○

FIGURE 4-1 (SHEET 2 OF 3)

Constituent Frequency and Relative Magnitude Detected by Media

DuPont East Chicago Current Conditions Report

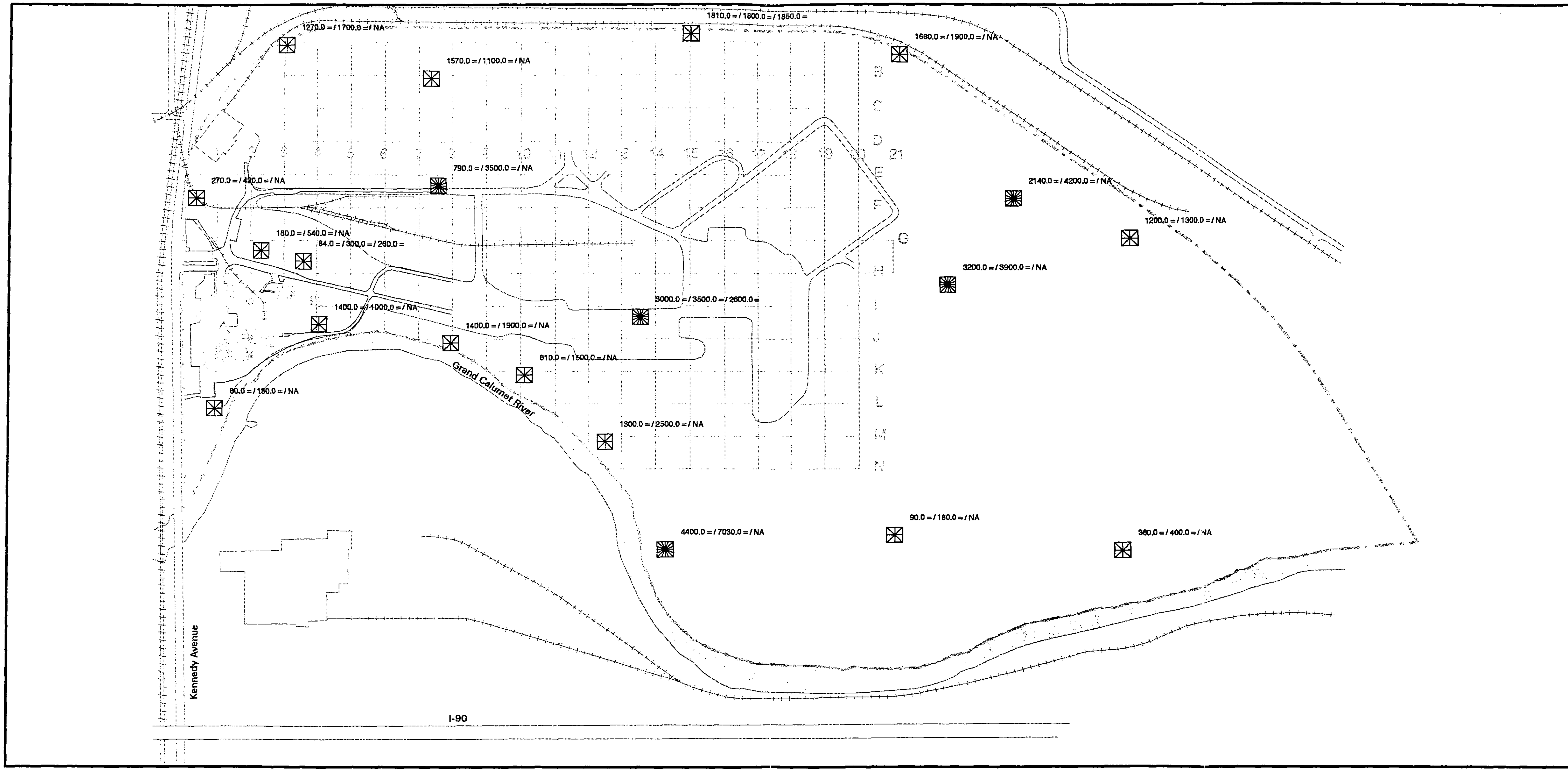
Constituent Groups and Constituents	Media		
	Soil	Groundwater—Top of Aquifer	Groundwater—Base of Aquifer
Volatile Organic Compounds (•'s in ppb)			
1,1,1-Trichloroethane		●●●○	●
Bromodichloromethane			●
Carbon disulfide			●●●●●●
Chloroform		●	●●
Methylene chloride			●
Toluene	●		
Trichlorofluoromethane	●	●○	●

FIGURE 4-1 (SHEET 3 OF 3)

Constituent Frequency and Relative Magnitude Detected by Media

DuPont East Chicago Current Conditions Report

CH2MHILL



Legend

DuPont Property Line

Concentration in mg/L (U - Detection Limit, = - Detected Value, NA - Not Analyzed)

Grab Sample Location <1 U; 1 U to <10; 10 to <100; 100 to <2,000; >=2,000

Monitoring Well Location <1 U; 1 U to <10; 10 to <100; 100 to <2,000; >=2,000

N

Scale 1:7200
1 inch = 600 feet

Sources:
DuPont and CH2M HILL

Notes:
Symbols centered over sample location.

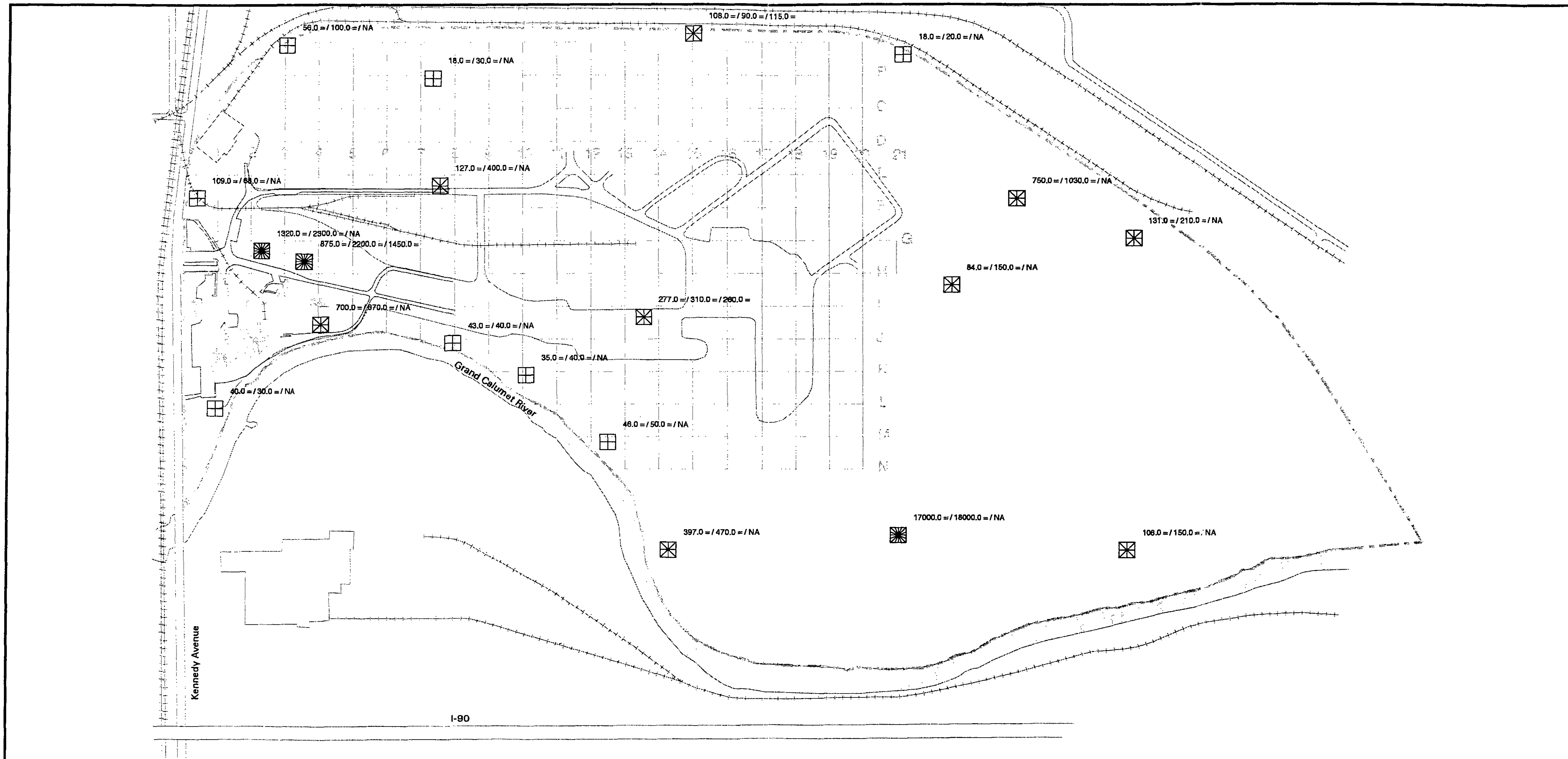
Multiple values at monitoring well locations reflect multiple rounds of sampling from Phase II - Round 1, Phase II - Round 2, and Phase III (e.g. 0.002/0.002/NA).

Figure 4-2
Sulfate Concentrations in Groundwater

DuPont East Chicago Current Conditions Report

CH2MHILL

October 22, 1997



Legend

DuPont Property Line

Concentration in mg/L (U - Detection Limit, = - Detected Value, NA - Not Analyzed)

Grab Sample Location	<1 U	1 U to <10	10 to <100	100 to <1,500	>=1500
Monitoring Well Location	<1 U	1 U to <10	10 to <100	100 to <1,500	>=1500

N

Scale 1:7200
1 inch = 600 feet

Sources:
DuPont and CH2M HILL

Notes:
Symbols centered over sample location.

Multiple values at monitoring well locations reflect multiple rounds of sampling from Phase II - Round 1, Phase II - Round 2, and Phase III (e.g. 0.002/0.002/NA).

Figure 4-3
Chloride Concentrations in Groundwater

DuPont East Chicago Current Conditions Report

CH2MHILL

October 22, 1997

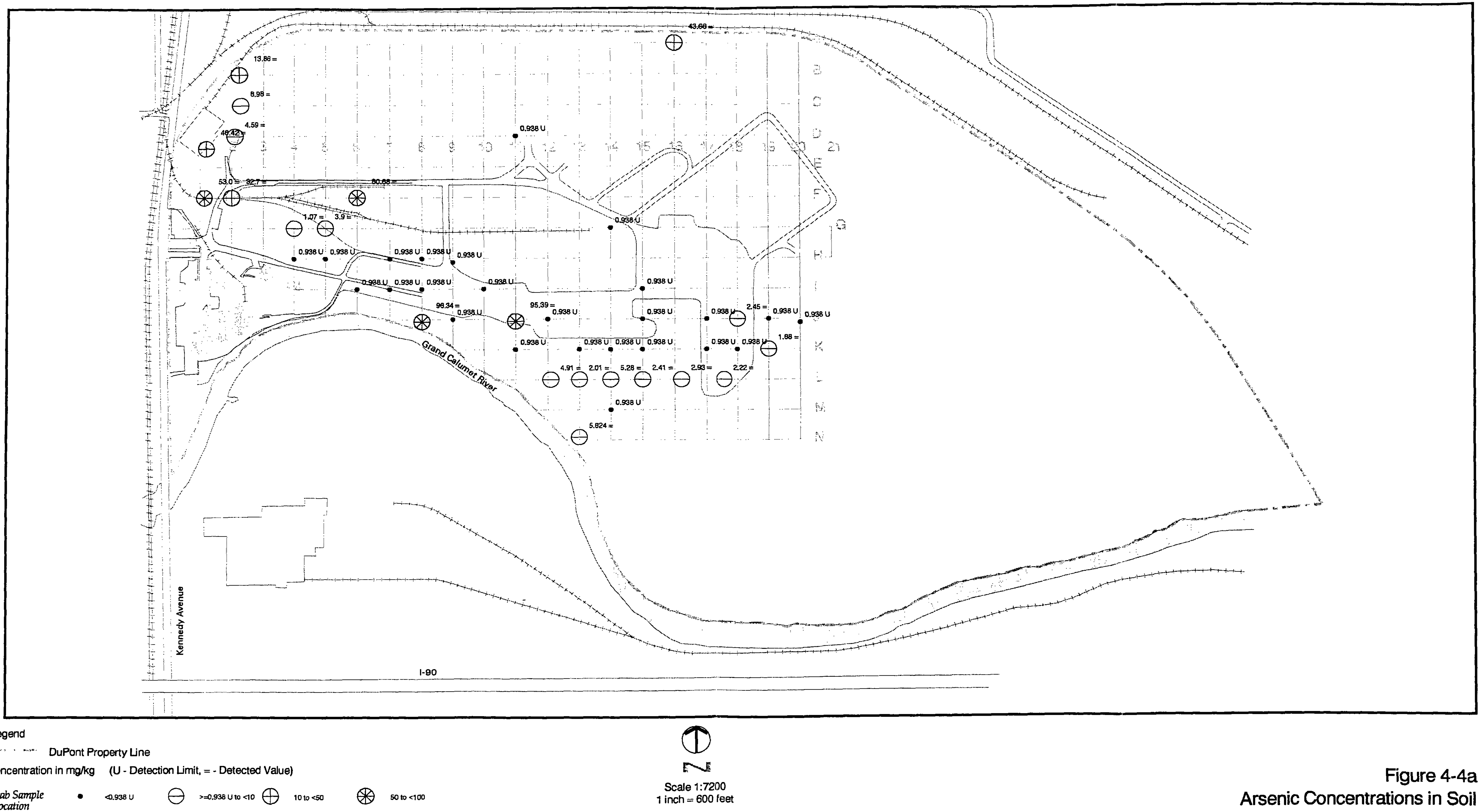


Figure 4-4a
Arsenic Concentrations in Soil

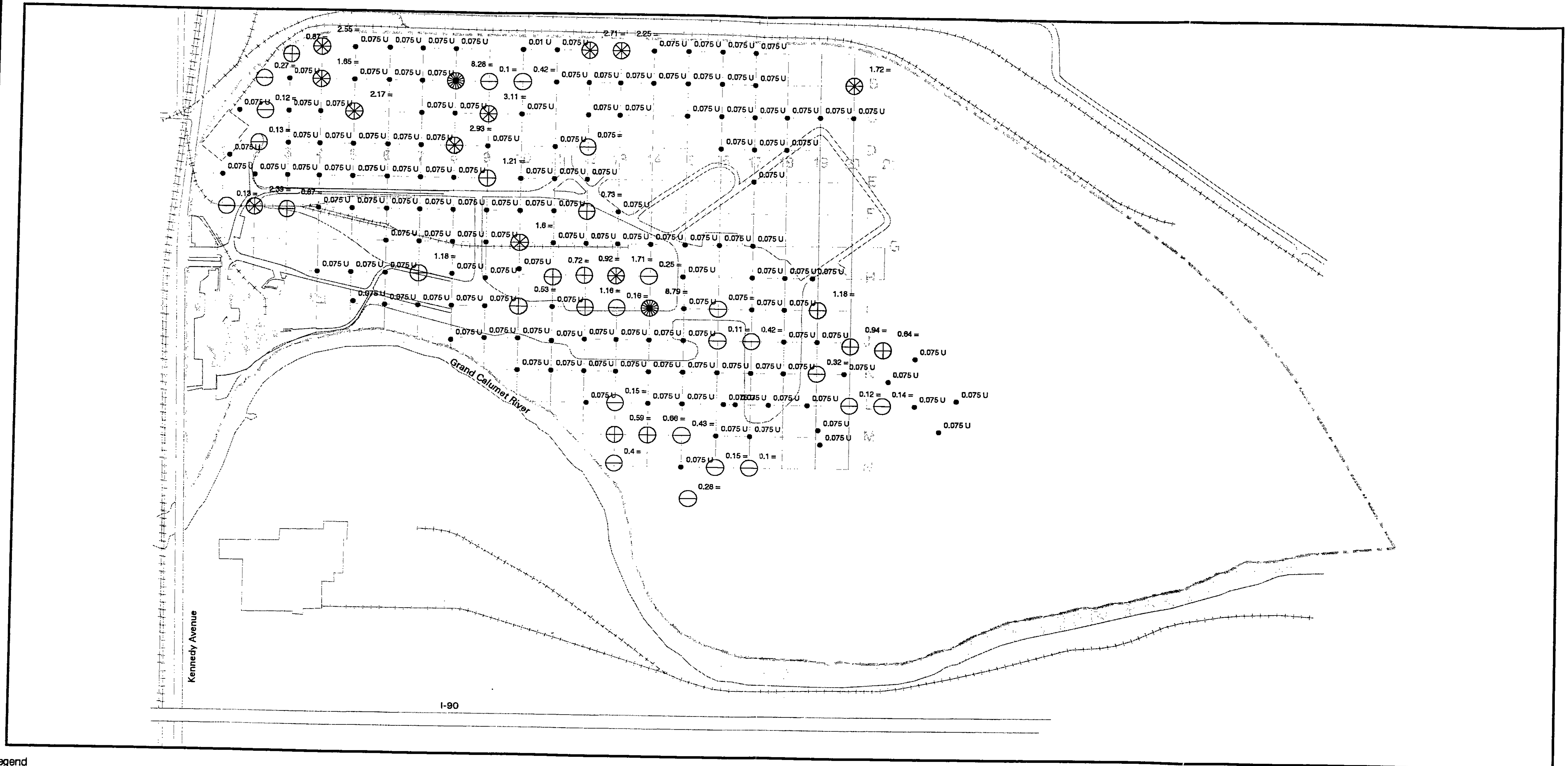
DuPont East Chicago Current Conditions Report

Sources:
DuPont and CH2M HILL

Note: Symbols centered over sample location.

CH2MHILL

October 22, 1997



Legend

DuPont Property Line

Concentration in mg/L (U - Detection Limit, = - Detected Value)

Grab Sample Location • <0.075 U ⊖ >=0.075 U to <0.5 ⊕ 0.5 to <1.5 ⊛ 1.5 to <5 ⊛ 5 to <10

N

Scale 1:7200
1 inch = 600 feet

Sources:
DuPont and CH2M HILL

Note: Symbols centered over sample location.

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Figure 4-4b
Arsenic Concentrations in Groundwater - Top of Aquifer

DuPont East Chicago Current Conditions Report

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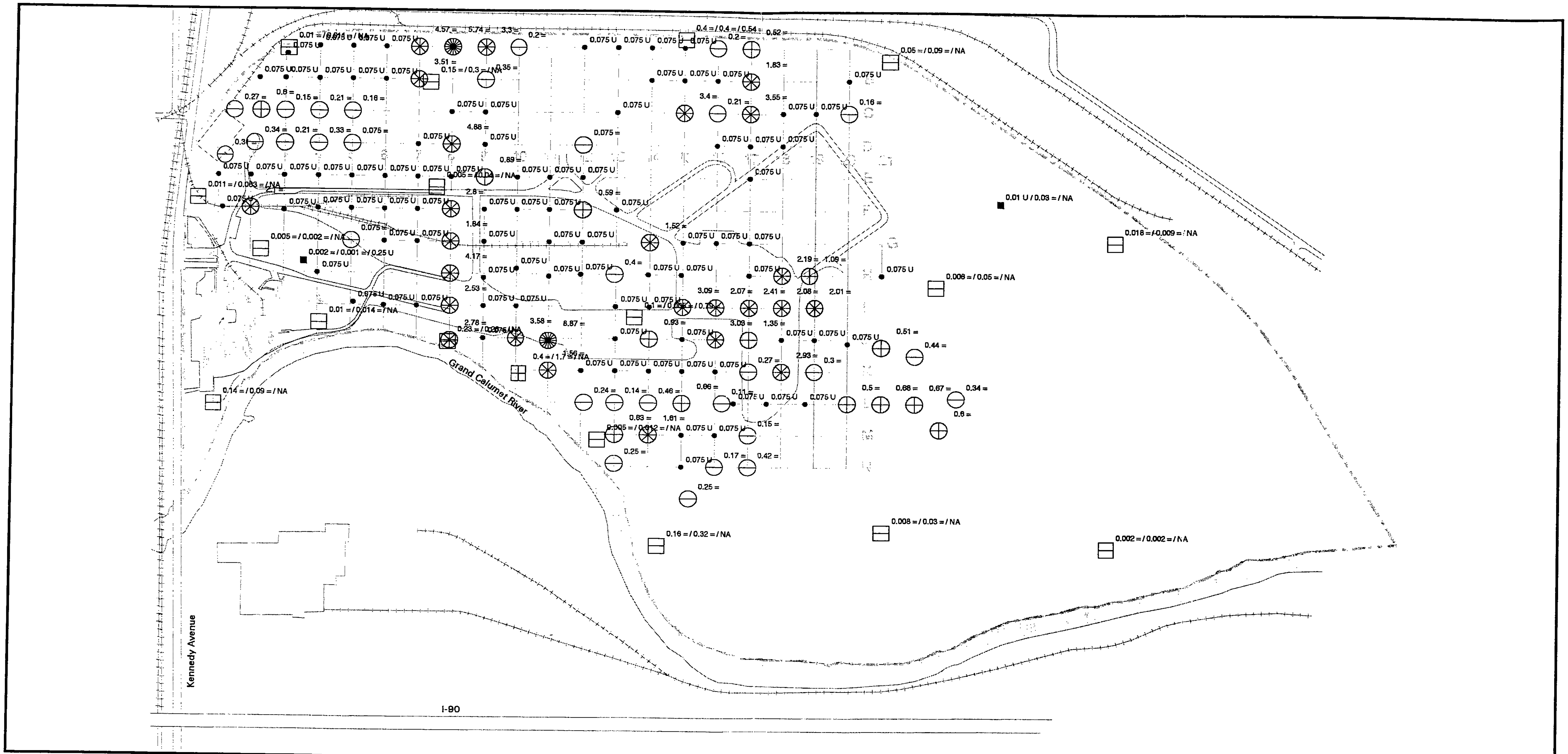

Legend

DuPont Property Line

Concentration in mg/L (U - Detection Limit, = - Detected Value, NA - Not Analyzed)

Grab Sample Location	<0.075 U	>=0.075 U to <0.5	0.5 to <1.5	1.5 to <5	5 to <10
Monitoring Well Location	<0.075 U	>=0.075 U to <0.5	0.5 to <1.5	1.5 to <5	5 to <10

N

Scale 1:7200
1 inch = 600 feet

Figure 4-4c
Arsenic Concentrations in Groundwater - Base of Aquifer

DuPont East Chicago Current Conditions Report

Sources:
DuPont and CH2M HILL

Notes:
Symbols centered over sample location.

Multiple values at monitoring well locations reflect multiple rounds of sampling from Phase II - Round 1, Phase II - Round 2, and Phase III (e.g. 0.002/0.002/NA).

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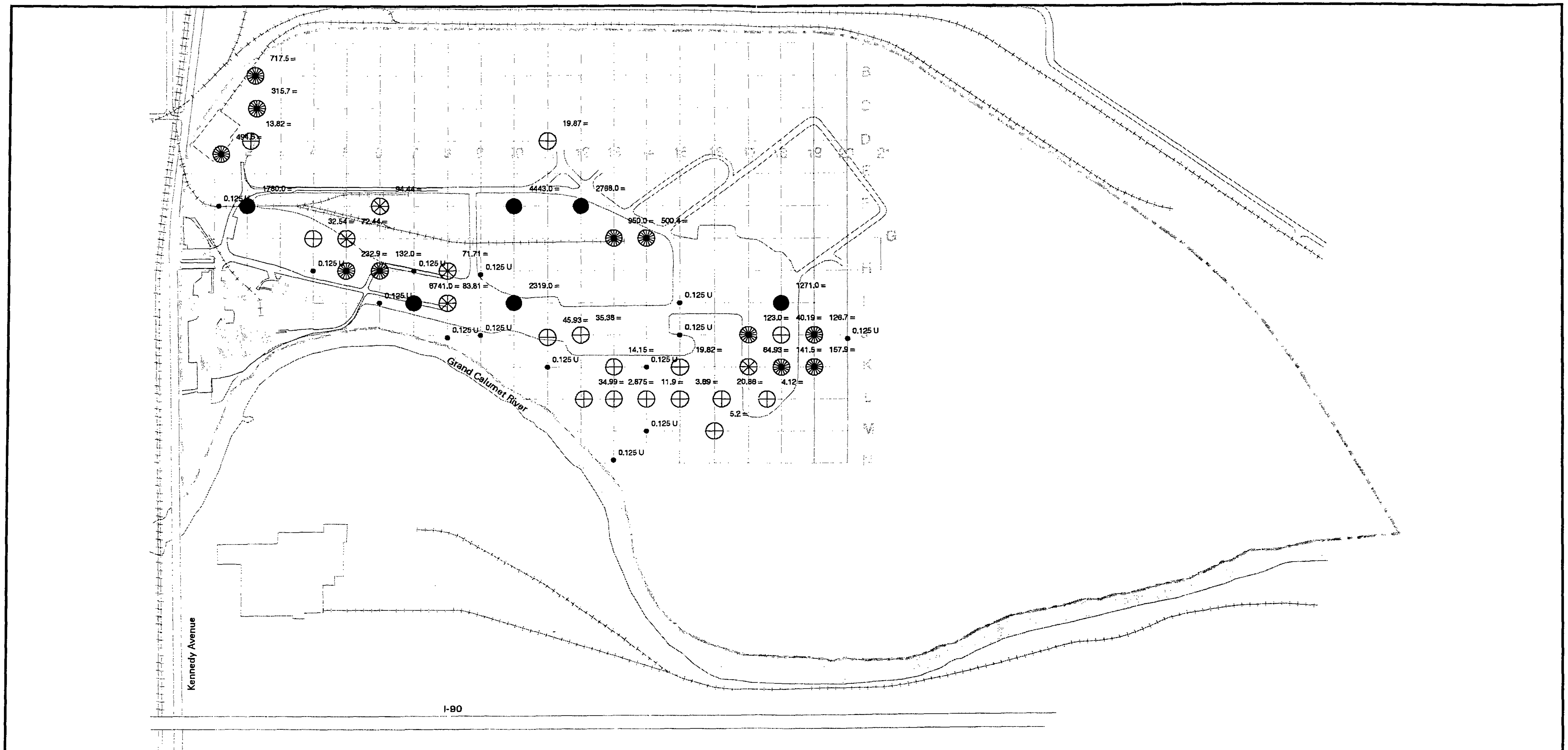


Legend

DuPont Property Line

Concentration in mg/kg (U - Detection Limit, = - Detected Value)

Grab Sample Location

<0.125 U

$>=0.125$ U to <1

1 to <50

50 to <100

100 to $<1{,}000$

1,000 to $<10{,}000$

N

Scale 1:7200
1 inch = 600 feet

Sources:
DuPont and CH2M HILL

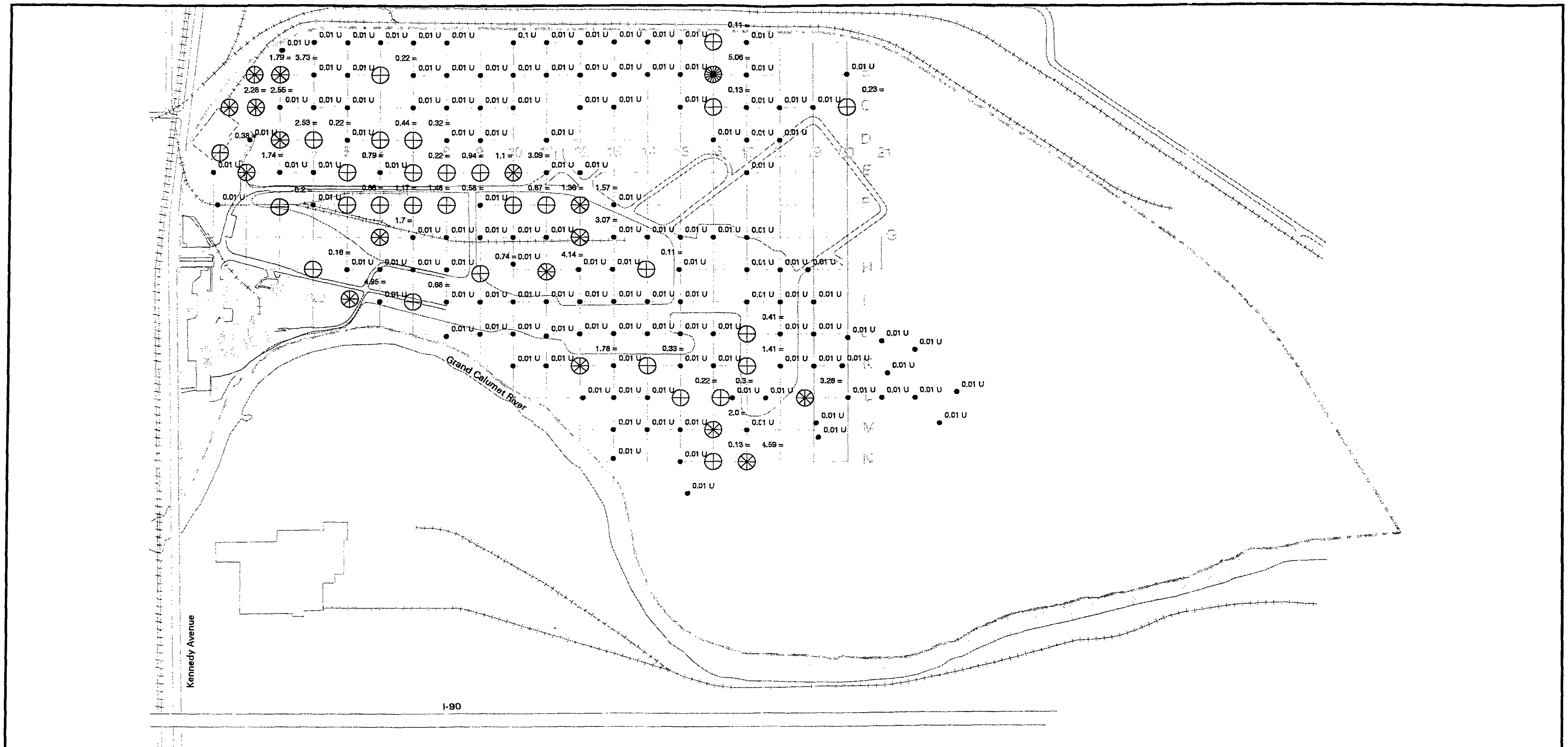
Note:
Symbols centered over sample location.

Figure 4-5a
Lead Concentrations in Soil

DuPont East Chicago Current Conditions Report

CH2MHILL

October 22, 1997



Legend

DuPont Property Line

Concentration in mg/L (U - Detection Limit, = - Detected Value)

Grab Sample Location • <0.01 U ⊖ >=0.01 U to <0.1 ⊕ 0.1 to <1.5 ⊛ 1.5 to <5 ⊛ 5 to <10

N

Scale 1:7200
1 inch = 600 feet

Figure 4-5b
Lead Concentrations in Groundwater - Top of Aquifer

DuPont East Chicago Current Conditions Report

Sources:
DuPont and CH2M HILL

Note:
Symbols centered over sample location.

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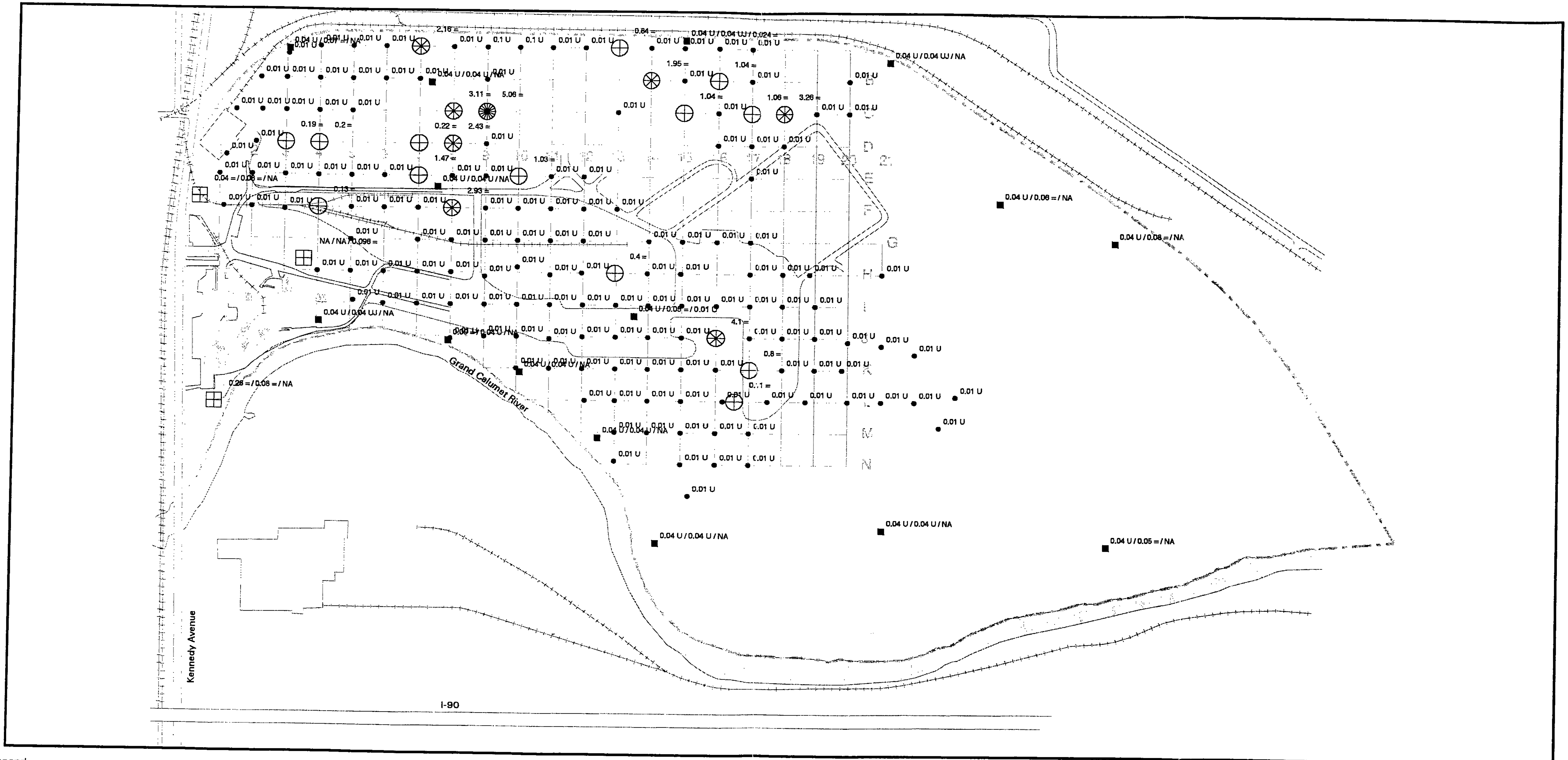

Legend

DuPont Property Line

Concentration in mg/L (U - Detection Limit, = - Detected Value, NA - Not Analyzed)

Grab Sample Location	<0.01 U	>=0.01 U to <0.5	0.5 to <1.5	1.5 to <5	5 to <10
Monitoring Well Location	<0.01 U	>=0.01 U to <0.5	0.5 to <1.5	1.5 to <5	5 to <10

N

Scale 1:7200
1 inch = 600 feet

Sources:
DuPont and CH2M HILL

Notes:
Symbols centered over sample location.

Multiple values at monitoring well locations reflect multiple rounds of sampling from Phase II - Round 1, Phase II - Round 2, and Phase III (e.g. 0.002/0.002/NA).

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Figure 4-5c
Lead Concentrations in Groundwater - Base of Aquifer

DuPont East Chicago Current Conditions Report

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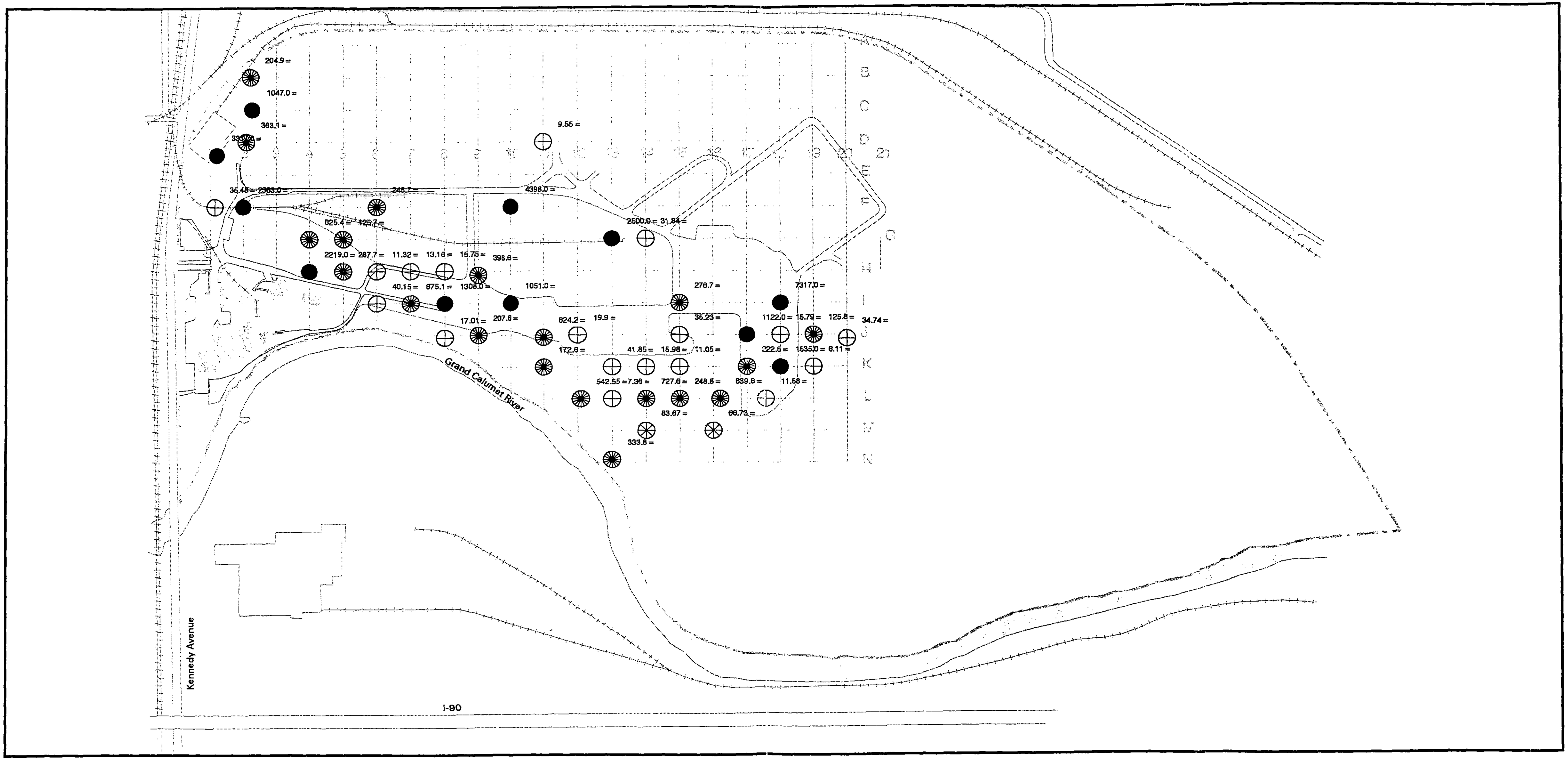


Legend

DuPont Property Line

Concentration in mg/kg (U - Detection Limit, = - Detected Value)

Grab Sample Location • <0.001 U ⊖ >=0.001 U to <1 ⊕ 1 to <50 50 to <100 100 to <1,000 ● 1,000 to <10,000

N

Scale 1:7200
1 inch = 600 feet

Figure 4-6a
Zinc Concentrations in Soil

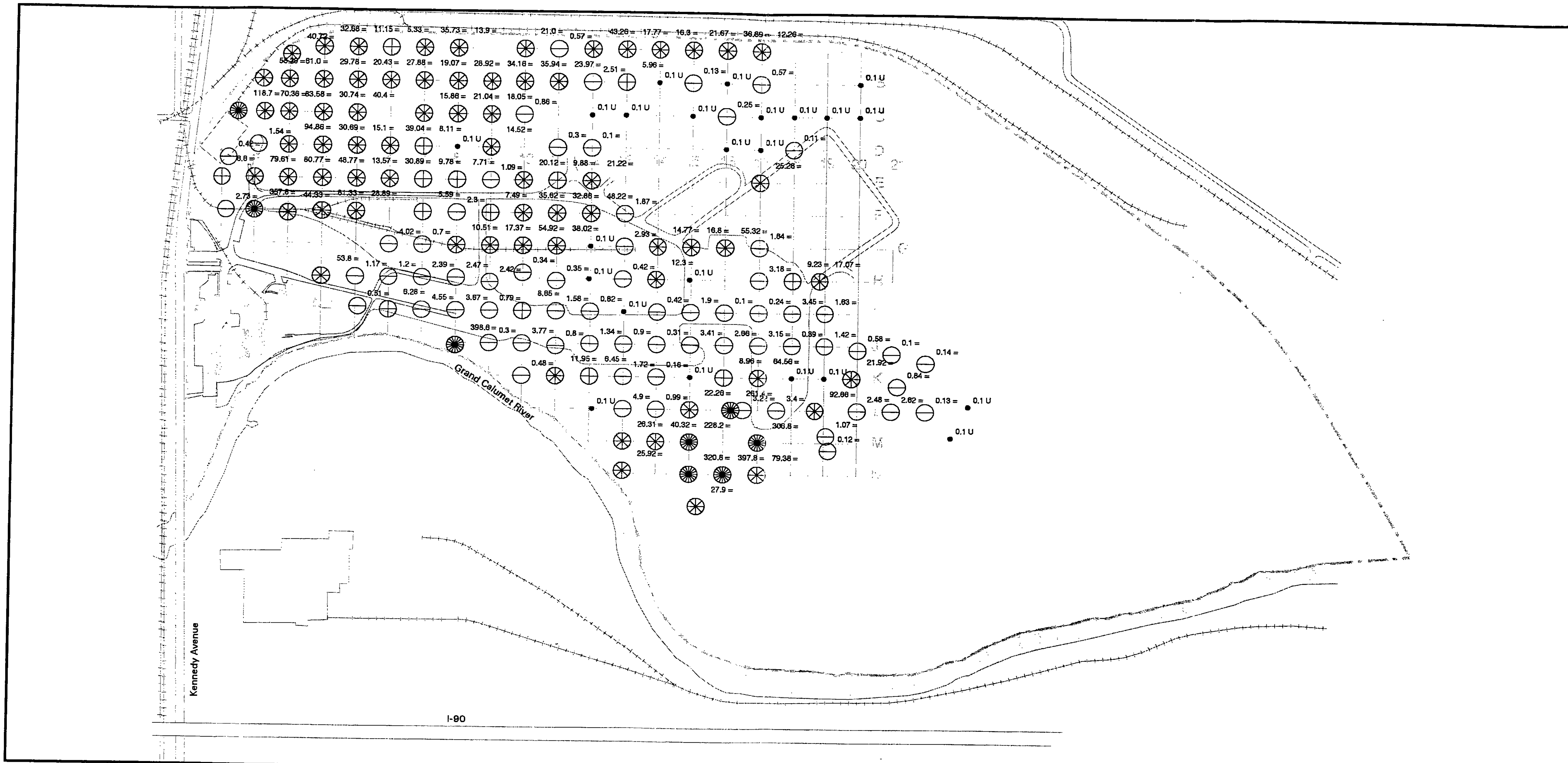
DuPont East Chicago Current Conditions Report

CH2MHILL

Sources:
DuPont and CH2M HILL

Note:
Symbols centered over sample location.

October 22, 1997



Legend

DuPont Property Line

Concentration in mg/L (U - Detection Limit, = - Detected Value)

Grab Sample Location

- <0.1 U
- >=0.1 U to <5
- 5 to <10
- 10 to <100
- 100 to <1,000

N

Scale 1:7200
1 inch = 600 feet

Sources:
DuPont and CH2M HILL

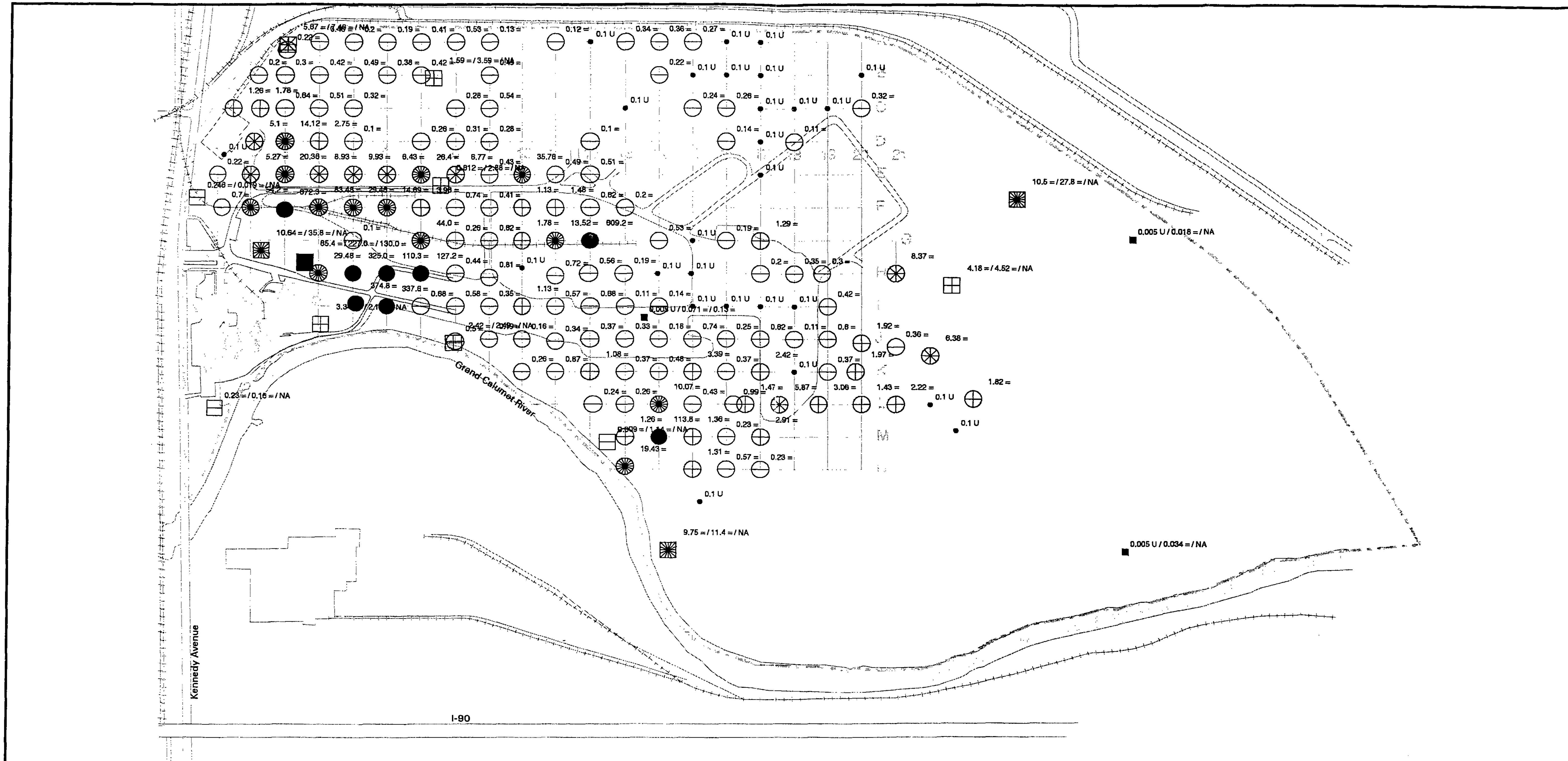
Note:
Symbols centered over sample location.

Figure 4-6b
Zinc Concentrations in Groundwater - Top of Aquifer

DuPont East Chicago Current Conditions Report

CH2MHILL

October 22, 1997



Legend

DuPont Property Line

Concentration in mg/L (U - Detection Limit, = - Detected Value, NA - Not Analyzed)

Grab Sample Location	<0.1 U	>=0.1 U to <1	1 to <5	5 to <10	10 to <100	100 to <1,000
Monitoring Well Location	<0.1 U	>=0.1 U to <1	1 to <5	5 to <10	10 to <100	100 to <1,000

N

Scale 1:7200
1 inch = 600 feet

Figure 4-6c
Zinc Concentrations in Groundwater - Base of Aquifer

DuPont East Chicago Current Conditions Report

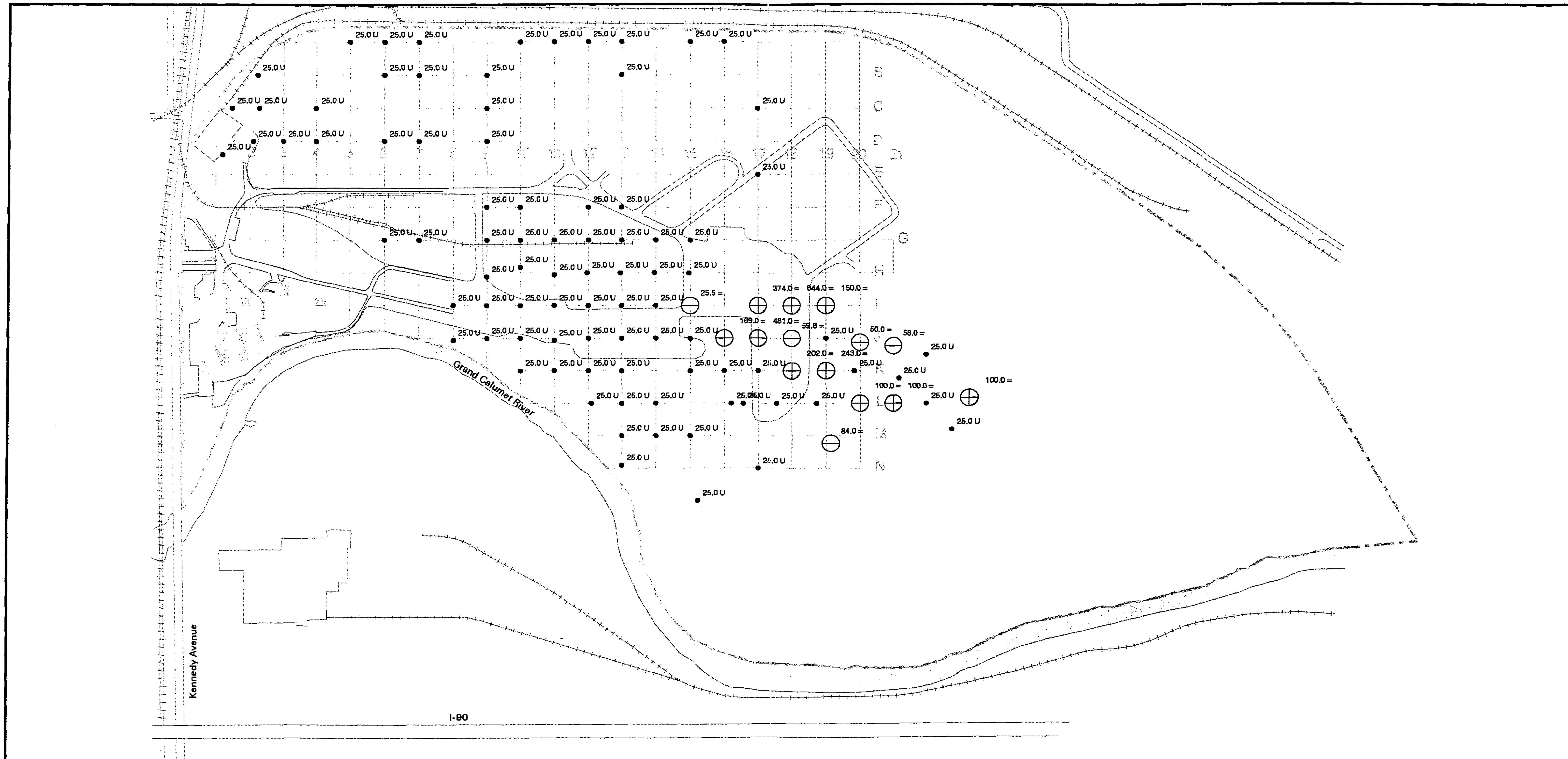
Sources:
DuPont and CH2M HILL

Notes:
Symbols centered over sample location.

Multiple values at monitoring well locations reflect multiple rounds of sampling from Phase II - Round 1, Phase II - Round 2, and Phase III (e.g. 0.002/0.002/NA).

CH2MHILL

October 22, 1997



Legend

DuPont Property Line

Concentration in ug/L (U - Detection Limit, = - Detected Value)

Grab Sample Location • <25 U ⊖ >=25 U to <100 ⊕ 100 to <1,000

N

Scale 1:7200
1 inch = 600 feet

Figure 4-7a
Freon Concentrations in Groundwater - Top of Aquifer

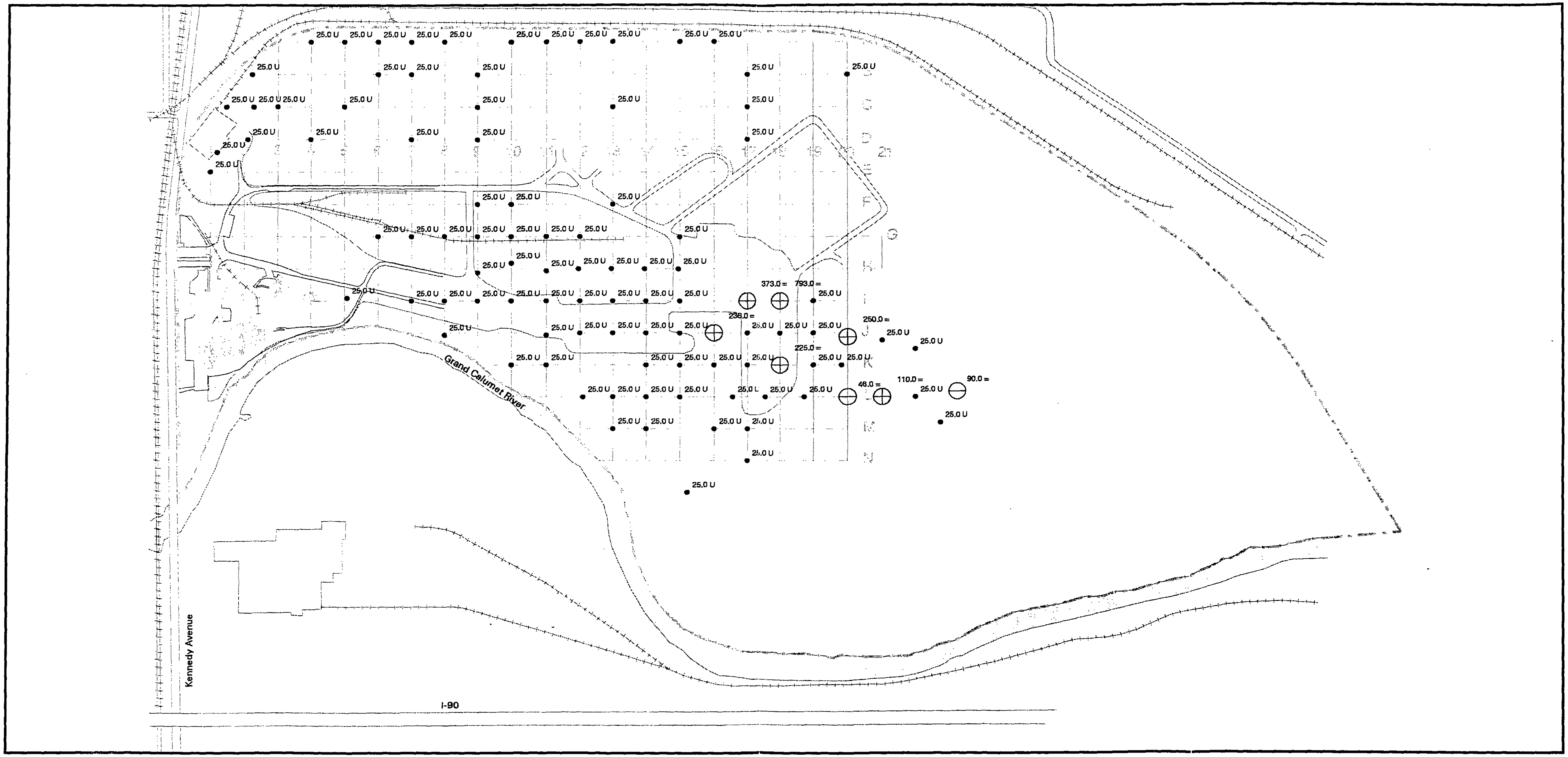
DuPont East Chicago Current Conditions Report

Sources:
DuPont and CH2M HILL

Note:
Symbols centered over sample location.

CH2MHILL

October 22, 1997



Legend

DuPont Property Line

Concentration in ug/L (U - Detection Limit, = - Detected Value, NA - Not Analyzed)

Grab Sample Location <25 U | >=25 U to <100 | 100 to <1,000

Monitoring Well Location <25 U | >=25 U to <100 | 100 to <1,000

Sources:
DuPont and CH2M HILL

Notes:
Symbols centered over sample location.

Multiple values at monitoring well locations reflect multiple rounds of sampling from Phase II - Round 1, Phase II - Round 2, and Phase III (e.g. 0.002/0.002/NA).

N

Scale 1:7200
1 inch = 600 feet

Figure 4-7b
Freon Concentrations in Groundwater - Base of Aquifer

DuPont East Chicago Current Conditions Report

CH2MHILL

October 22, 1997

CHAPTER 5

Preliminary Conceptual Facility Model

This chapter presents the preliminary conceptual facility model of known conditions at the DuPont East Chicago facility, based on the information presented in the preceding chapters. The purpose of the model is to provide a basis for summarizing and visualizing the relationships between use of the land and constituents detected, human influence on the presence and distribution of constituents in environmental media, their spread and fate in the environment, and their potential effect on the environment.

The model consists of figures and tables that illustrate key concepts regarding:

- Site conditions that affect chemical mobility
- Migration pathways
- Known information on the abundance and average concentrations of constituents
- Potential migration pathways and potential receptors

The figures and tables are supplemented by text describing key features of the model and conditions not readily represented in pictorial or tabular form.

The model is an integrated representation of the most pertinent information available for the facility. It will be refined to reflect the knowledge of site conditions obtained from future supplemental evaluations, subsequent RFI, or other associated RCRA corrective action activities. At this time, the model is incomplete. Information relating to the following topics will be needed in order to complete the model:

- The presence of releases at the SWMUs and AOCs
- The characterization of releases (if present) at SWMUs or AOCs
- The presence of completed migration pathways between known sources and potential receptors
- The concentrations of constituents at points of exposure, as warranted

The model, in its current state, can be used as a tool for communicating information and planning future work. Specifically, it will be used as a guide for:

- Planning the RFI
- Evaluating alternatives for interim stabilization measures
- Evaluating alternatives for corrective measures

Site Physical Conditions

The site is bordered by a road, railroads, a property owned by the City of East Chicago, and the East Branch of the Grand Calumet System. Beyond those properties lie U.S.S. Lead on the west; the Riley Park area on the north-northwest; a salvage yard and trucking operations on the north; petroleum storage facilities on the north-northeast; a former incinerator, a solid waste transfer station, and the East Chicago Central Services Center on the east; and Harbison-Walker Refractories and petroleum storage facilities on the south.

The facility comprises four main areas: (1) the active manufacturing area; (2) the previously active manufacturing area; (3) waste management areas outside the manufacturing area; and (4) a natural area. These areas are illustrated on the surface of the three-dimensional representation of the facility shown in Figure 5-1. The land surface within the active and previously active manufacturing areas and almost all the waste management areas consist of fill of one kind or another. Most of the land surface consists of these three areas. An area in the eastern part of the "natural area" is included as part of the waste management area in the model because of the presence of fill along the bank associated with channel relocation. The natural area consists primarily of natural sand, and its surface exhibits the dune and swale topography present in the region prior to development.

Vegetative cover is well-developed in the natural area and is becoming established throughout the waste management areas. Little habitat exists within the active and previously active manufacturing areas, where roads, paved areas, and rubble cover the land surface. Precipitation readily infiltrates the permeable fill and sand deposits present at the facility. Storms generate little runoff because of infiltration and the flat surface topography.

Groundwater is present 0 to 10 feet below the land surface in the thin sand unit underlying the facility. The aquifer material is sand and, in some instances, the fill or peat overlying the sand. The base of the sand is about 35 feet beneath the land surface. The sand lies upon a relatively flat impermeable clay till. The saturated portion of these deposits is only 25 feet thick. These physical relationships are illustrated in transect A–A′ in Figure 5-1 and transect B–B′ in Figure 5-2.

Groundwater flow is away from an east-west groundwater divide that runs through the developed part of the facility. On the south side of the divide, all the groundwater flows south toward and discharges to the waterway. On the north side of the divide, groundwater flows to the north toward Riley Park, the salvage yard, and the trucking operations. A hydraulic divide exists in Riley Park to the north (Figure 5-2). Most of the groundwater that migrates into Riley Park from the DuPont facility discharges to leaking sewers and sumps in the southern half of this area. Mounding may occur at the northeastern edge of the previously active manufacturing area.

Potential Sources

Conceivably, all the SWMUs and AOCs present at the facility could be potential sources for contamination. Based on available environmental quality data and knowledge of unit/area characteristics or historic operations, some units (e.g., hydrochloric acid neutralization pit, rubble area, and zinc roasters area) are more likely to have had a release than units such as the current satellite accumulation areas and the flue dust storage areas. However, a determination as to whether the SWMUs and AOCs are actual sources of releases has not yet been performed. The location of the SWMUs within the context of the conceptual model is illustrated in Figure 5-3.

Current Understanding of Constituents Detections and Distribution

Environmental quality conditions, as characterized to date, are consistent with the history of the site. The constituents most frequently detected in the environmental media are inorganic compounds, particularly major ions, water quality parameters, and common metals that occur naturally in the environment (e.g., aluminum, calcium, carbonate, chloride, fluoride, iron, magnesium, sulfate). Several of these constituents are primary components of products made at the facility. Select trace metals (e.g., arsenic, barium, lead, and zinc) that were primary components of products are also present. Inorganic constituents present as trace components in products and waste streams (e.g., antimony, chromium) were also detected. In general, the distribution of constituents (like chloride, fluoride, nitrate, phosphate, sulfate, and trace metals) is compatible with a history of acids and inorganic chemical manufacturing.

Organics were rarely detected in the environmental media at the site. The compounds typically were detected in less than 5 percent of the samples tested and only in isolated locations. The only constituent detected in soil and groundwater at multiple locations in a discernible area was Freon, which was detected in and near the former Freon manufacturing area.

In general, existing environmental quality data are not adequate to assess the nature and extent of potential effects on surface or subsurface soils at the site. Existing groundwater data provide a fair understanding of the type of constituents present and their distribution across the site as a whole, but they are not likely to be sufficient to confirm releases or to identify potential sources. Furthermore, existing data do not clearly describe relationships between soil and groundwater conditions, or changes in constituent concentrations along potential pathways.

Constituent Mobility and Fate and Transport Factors

The primary constituents detected in environmental media at the facility are inorganic compounds that are abundant in the natural environment and were also used in the manufacturing of certain products (e.g., sulfate, chloride, fluoride, arsenic, barium, lead, and zinc). Even though some organic chemical were manufactured at the facility in the past, few that could be attributed to those operations (most notably Freon) were detected in environmental media at more than a half-dozen locations.

The mobility of these constituents and, therefore, their migration potential, are affected by several factors. The characteristics or processes affecting the mobility of constituents detected in soil and groundwater at the facility are summarized in Table 5-1. The processes affecting constituent mobility are illustrated in Figures 5-4a and 5-4b. Many constituents detected in environmental media at the East Chicago facility are mobile under certain conditions that could have occurred at the facility in the past.

This model recognizes that most of the metals detected at the facility are leachable under low pH conditions (temporary conditions in the past, whenever an acid was spilled on the ground). The metals detected may be present because of their presence in fill, or they may be present as a waste. Metals dissolved in groundwater migrate in the subsurface as the groundwater flows.

Some dissolved metals can be absorbed to the soil matrix as they migrate along groundwater pathways. This process is expected when the flow path is through the peat near the top of the aquifer. Dissolved metals can precipitate as they encounter oxidizing conditions. They can form complexes in the presence of aluminum oxides and iron oxides expected to be present in at least some of the onsite fill. For these reasons, it is anticipated that concentrations at the facility perimeter would be lower than those detected at the facility interior. Additional reactions can occur at the groundwater and surface water interface (e.g., precipitation).

Nonmetal inorganics are mobile but are affected by processes or reactions that occur as they migrate toward a point of discharge (e.g., chloride is nonreactive; sulfate is slightly reactive). Dispersion and mixing with clean recharge are the few processes that can diminish concentrations of nonreactive constituents as they migrate from their point of entry into the groundwater flow system toward discharge areas. Chemical reactions can also occur upon discharge to surface waters.

As a group, the organics detected have moderate solubility, high volatility, high leachability, low bioaccumulation, and low to high biodegradation. Of those detected onsite, only carbon disulfide has a high bioaccumulation potential. Volatile constituents are mobile and do not persist in surface soil. They persist in groundwater but are subject to some natural attenuation. Under oxidizing conditions, several biodegrade (e.g. toluene and chloroform).

Potential Migration Pathways and Mitigating Factors

Potential migration pathways for constituents detected at the facility and mitigating factors have been identified and evaluated based on existing information regarding current conditions at the facility, and on readily available information regarding human and environmental populations (Figure 5-5). The constituent chemical and physical properties also mitigate constituent mobility in the environment, particularly along the potential exposure pathways identified for the site.

The potential for migration and transport of facility-related constituents to potential receptor locations is limited to three potential migration pathways at the DuPont site. Based on the chemical and physical properties of the potential constituents and the known physical, topographic, meteorological, and hydrologic conditions at the facility, those pathways are:

- Dissolved constituents in groundwater beneath manufacturing areas and waste management areas at the facility to downgradient locations
- Stormwater runoff from manufacturing areas on the facility or waste management areas along drainage pathways to discharge points
- Airborne transport of particulates generated by wind erosion and physical disturbance of surface soils in the active portions of the facility or waste management areas to downwind locations

Various conditions at the facility and in nearby areas serve to limit the potential for transport or migration of facility-related constituents through these potential pathways.

Dissolved Constituents in Groundwater

Based on the results of previous site and regional investigations, significant vertical migration of groundwater is effectively retarded by subsurface lithology, and flow is generally restricted to horizontal movement in the Calumet Aquifer (CH2M HILL 1991). Horizontal flow paths within the facility boundary are controlled by the presence of a groundwater divide running east to west through the facility. Because of the flow regime at the site, little groundwater potentially affected by facility-related constituents is likely to migrate offsite to the east or west. Northward groundwater flow far beyond the facility boundary is limited by the presence of a second divide in the center of the Riley Park area, and southward flow is limited by the East Branch of the Grand Calumet System, which acts as a hydraulic barrier to flow farther southward.

Based on previous sampling results for Riley Park and the north side of the facility (see Volume 2), concentrations of potential facility-related constituents collected from sewers and sumps (that may contain constituents from other sources) have been shown to decrease with distance from the facility (CH2M HILL 1991). If such conditions are related to the facility, these findings would indicate that some retardation and natural attenuation is occurring in the subsurface. The presence of peat (subsurface soil layers with high organic carbon content) below the manufacturing areas is likely to reduce the potential for contact with unattenuated levels of site constituents. Because of variations in chemical conditions along these potential flow paths, dissolved constituents probably undergo significant chemical alterations upon seepage or discharge to surface waters and interactions with air and sediments.

Surficial Runoff

Little evidence exists to suggest that significant surface soil contamination is present at the facility. If facility-related constituents were present in the upper 10 centimeters of the soil column, they may be subject to transport by this mechanism. The potential for this pathway to be of significance is reduced further by the existence of pavement and vegetation over much of the manufacturing and waste management areas. Exposed surface soils at the facility are typically coarse sands that tend to reduce the potential for runoff. Furthermore, the surface topography in the manufacturing area and waste management areas is relatively flat, with limited areas having sufficient relief for sheet flow and transport.

Effective physical barriers exist to contain migration of the limited amount of runoff that may occur from the manufacturing areas and waste management areas. To the north of the facility, drainage ditches and ballast within the railroad right-of-way act as a physical barrier to further transport. Constituents entrained in surface runoff may be trapped in and be deposited low-lying areas. To the southeast and east, native soils in low spots in the natural area of the facility generally have higher organic content, which may further retard migration.

Airborne Particulates

As noted, little evidence exists to suggest that significant surface soil contamination is present at the facility. Much of the manufacturing areas and waste management areas is paved or vegetated. Coarse sands typically cover the few open areas. As such, little soil mass within the top 10 centimeters of the soil column would be prone to entrainment of facility-related constituents or to mobilization as airborne particulate matter. To the limited extent that such mobilization could occur, prevailing winds in the region generally would not transport material toward the identified receptor locations.

Potential Human Receptors and Mitigating Factors

Human receptors potentially subject to direct or indirect contact with facility-related constituents are limited in both number and location (see Volume 2). Based on known land use and activity patterns around the facility, the following potential receptors have been preliminarily identified:

- Some residents in the southern part of the Riley Park neighborhood
- Infrequent trespassers on the natural area
- Hypothetical recreators using the reach of the East Branch immediately adjacent to the facility

Although physical contact between the potential receptors and facility-related constituents is possible, several factors mitigate the potential for such contact. They include physical barriers, seasonal considerations, and aesthetic conditions that tend to preclude activity patterns that could result in consistent, frequent, or long-term opportunities for contact with environmental media. These mitigative factors are described below for each potential receptor group.

Trespassers

Trespassing on the DuPont property has been sporadic and infrequent. A chainlink fence is maintained along the facility boundary to restrict access to the property, and a security guard is present onsite. To the extent that it occurs, trespassing is limited to the undeveloped natural area in the eastern part of the property, and then only to the warm weather months. Trespassers have been observed in the northeast ridge and swale topography and by the power lines, away from manufacturing or waste management areas. When present, trespassers' activities are believed to lead to minimal contact with environmental media (e.g., off-road vehicle use).

Residents

Based on door-to-door survey results, it is known that groundwater is not used for domestic water supply in the Riley Park area (CH2M HILL 1991). If contact with facility-related constituents were to occur there, it would be restricted primarily to environmental media indirectly affected by groundwater discharges and limited to a small subset of property owners in the southern part of the community (CH2M HILL 1991). Few residents, if any, have direct contact with groundwater within the potentially affected area.

Recreators

Recreational use of the East Branch of the Grand Calumet System is virtually nonexistent for various reasons. Water access to the East Branch (and particularly the reach adjacent to the DuPont facility) is limited because of the lack of public launching areas and the presence of low bridges spanning the river channel. Land access to the stream banks on the DuPont facility is limited by the site security, the presence of vegetation, marshy areas, and, in some areas, steep banks, making public use of the waterway from its stream banks unlikely. To the extent that the area may be used by recreators, such use would be restricted to warm weather months.

The general appearance of the waterway and riparian areas, particularly downstream of combined sewer outfalls, discourages its use by recreators and limits the activities they would likely undertake to those not associated with direct contact with aquatic media. Moreover, abundant water recreation opportunities exist nearby at more aesthetically desirable areas (e.g., Lake Michigan), making frequent or long-term use of the East Branch of the Grand Calumet System for water recreation highly unlikely.

Potential Ecological Receptors and Mitigating Factors

Potentially viable habitat exists on parts of the DuPont facility and also within the riparian zone of the East Branch and wetland areas along the southern facility boundary. Those areas may harbor plant and animal species that could come into contact with facility-related constituents in environmental media. The general categories of ecological receptors of potential interest are aquatic plants, aquatic invertebrates, terrestrial plants, terrestrial invertebrates, fish, and wildlife that may inhabit those areas. Wildlife is defined as any amphibian, reptile, bird or mammal species that uses an area as breeding or foraging habitat.

Occurrence of species designated with special status by the Indiana Department of Natural Resources or the U.S. Fish and Wildlife Service has been documented in the area. These species may also be of potential concern as ecological receptors. Species of special status that have been observed at the DuPont facility are listed in Table 5-2.

Issues pertinent to potential facility-related effects on the East Branch are being addressed under the Sediment Characterization effort. It should be noted, however, that the background water and sediment quality in the East Branch (i.e., locations upstream from Cline Avenue) and its associated aquatic resources are impaired because of the general conditions prevalent as a result of long-term industrial development in the region (U.S. Army COE 1997; U.S. FWS 1991; Hoke et al. 1993).

Life history characteristics of many species of potential ecological receptors may serve to minimize their potential for contact with media affected by facility-related constituents. Many resident fish and wildlife species (particularly higher trophic level species) tend to occupy a large home range and to use wide spatial areas as habitat. In addition, foraging habits and prey availability tend to result in a highly variable diet for many predatory species. These factors make long-term contact with environmental media at any single location or through consumption of any single species highly improbable. Likewise, migratory or nonresident species will generally use an area only infrequently and transitorily, making long-term contact with media by migratory or nonresident species at any single location highly unlikely.

Summary of Potential Impacts

The number and locations of potential human and ecological receptors likely to contact facility-related constituents are limited and confined to areas on or near the facility. Several factors related to activity patterns, physical barriers, seasonal considerations and aesthetic conditions serve to reduce the likelihood for contact with potentially affected media.

Physical and meteorological conditions at the facility and surrounding areas would preclude migration of a significant constituent mass by airborne particulate matter to potential receptor locations. As such, it is unlikely that airborne particulates would constitute a significant pathway for potential receptors. Physical and topographic conditions at the site limit the potential for surface water runoff and therefore would preclude migration of significant constituent mass to potential onsite receptor locations by surficial runoff. Relative to known background conditions, it is unlikely that the groundwater pathway contributes a significant incremental loading to the East Branch of the Grand Calumet System or associated riparian wetland habitats (CH2M HILL 1991).

Although limited constituent transport by all potential pathways identified is theoretically possible, none is likely to result in significant concentrations at potential receptor locations nor in significant short- or long-term contact by potential receptor populations. As such, releases of potentially facility-related constituents pose no known imminent threats to human health or the environment, based on information available for the site.

Path Forward

The corrective action process proposed for implementation at the East Chicago facility is shown in Figure 5-6. The site is currently in the RCRA Facility Assessment (RFA) stage, and a preliminary conceptual model of the site has been developed. The next step in the process is to conduct a RCRA Facility Investigation (RFI).

The RFI (as shown in the figure) consists of several activities, but will focus on the SWMUs and AOCs identified in this report. The first activity will determine if the existing data are adequate to determine whether a release from a specific unit or group of units of occurred. If sufficient data do not exist for release determination, then additional data will be collected during a confirmatory sampling program completed as part of the RFI. Next, an evaluation process will be completed for SWMUs at which releases has been identified. This process will utilize specific criteria for prioritizing SWMUs and AOCs with respect to effects on human health or the environment for further investigation under the RFI. These criteria will include at a minimum:

- Potential to cause fire or explosion if ignitable contents are present
- Release of volatile organic constituents to the air, which could result in inhalation of airborne constituents
- Lateral or vertical releases from the surface disposed material, upwardly migrating constituents that may be contacted directly
- Vertical releases to groundwater, which could cause constituents to enter the groundwater and cause exposure by ingestion, inhalation, or direct contact

Units identified as having a high potential for causing environmental effects will be focused on during the initial phase of the RFI. Data generated from the RFI will be compared to applicable criteria (i.e., action levels) to determine if further corrective action measures are warranted.

A work plan that documents these tasks and describes the activities to be completed as part of the RFI will be submitted to the U.S. EPA for review and approval in the first quarter

1998. The activities delineated in the RFI Work Plan will be implemented upon approval by U.S. EPA.

TABLE 5-1
Constituent Fate and Transport Properties

Chemical Group	Solubility	Volatility	Leachability	Bioaccumulation	Biodegradation
Major Inorganics and Water Quality Parameters					
Ammonia	N/A	High at high pH, low otherwise	High	Low	High under aerobic conditions, not under anaerobic conditions
Calcium	N/A	N/A	High, lower at high pH and when alkalinity or sulfate is high	High	Low
Carbonates	N/A	High at low pH,	High	Low	High under anaerobic conditions, not
Chloride	N/A	N/A	High	High	Low
Fluoride	N/A	N/A	Generally high, lower if Ca^{2+} is available	Moderate to high	Low
Magnesium	N/A	N/A	High	High	Low
Nitrate	N/A	N/A	High	Low	High under anaerobic conditions, not under aerobic conditions
Phosphate	N/A	N/A	High	High for some bacteria, low otherwise	Low
Potassium	N/A	N/A	High	Low	Low
Sodium	N/A	N/A	High	Low	Low
Sulfate	N/A	N/A	High	Low	High under anaerobic conditions, not under aerobic conditions
Common Metals					
Aluminum	N/A	N/A	High at low pHs (< 4) and with organic complexes, low otherwise	Moderate to high	Low
Iron	N/A	N/A	High at low redox (DO < 0.5 mg/L) and high redox with low pH, low otherwise	Moderate to high	Low
Manganese	N/A	N/A	High at low to moderate redox and high redox with low pH, low otherwise	Moderate to high	Low

TABLE 5-1
Constituent Fate and Transport Properties
(Page 2 of 3)

Chemical Group	Solubility	Volatility	Leachability	Bioaccumulation	Biodegradation
Trace Metals/Inorganics					
Antimony	N/A	N/A	High at low pH, low otherwise	Moderate to high	Low
Arsenic	N/A	N/A	High at low pH, low otherwise	Moderate to high	Low
Barium	N/A	N/A	High at low pH or if sulfate is not available, low otherwise	Moderate to high	Low
Boron	N/A	N/A	High	Moderate to high	Low
Cadmium	N/A	N/A	High at low pH, low otherwise	Moderate to high	Low
Copper	N/A	N/A	High at low pH, low otherwise	Moderate to high	Low
Chromium	N/A	N/A	High under oxidizing conditions (D.O. > 1 mg/L, Cr^{6+} dominant specie), high under reducing conditions (Cr^{3+} dominant) and low pH, low otherwise	Moderate to high	Low
Cyanide	High	High at low pH, low otherwise	High	Low	High
Lead	N/A	N/A	High at low pH and when alkalinity is low, low otherwise	Moderate to high	Low
Nickel	N/A	N/A	Moderate	Moderate to high	Low
Vanadium	N/A	N/A	High under oxidizing conditions (D.O. > 1 mg/L), high under reducing conditions and low pH (M4), low otherwise	Moderate to high	Low
Zinc	N/A	N/A	High at low pH, low otherwise	Moderate to high	Low
VOCs					
1,1,1-Trichloroethane	Moderate	High	High	Low	Low
1,1-Dichloroethane	Moderate	High	High	Low	Low
Bromodichloromethane	Moderate	High	Moderate to high	Low	Low
Carbon Disulfide	Moderate	High	High	High	Low
Chloroform	Moderate	High	High	Low	Moderate
Dibromodichloromethane	Moderate			Low	Low

TABLE 5-1
Constituent Fate and Transport Properties
(Page 3 of 3)

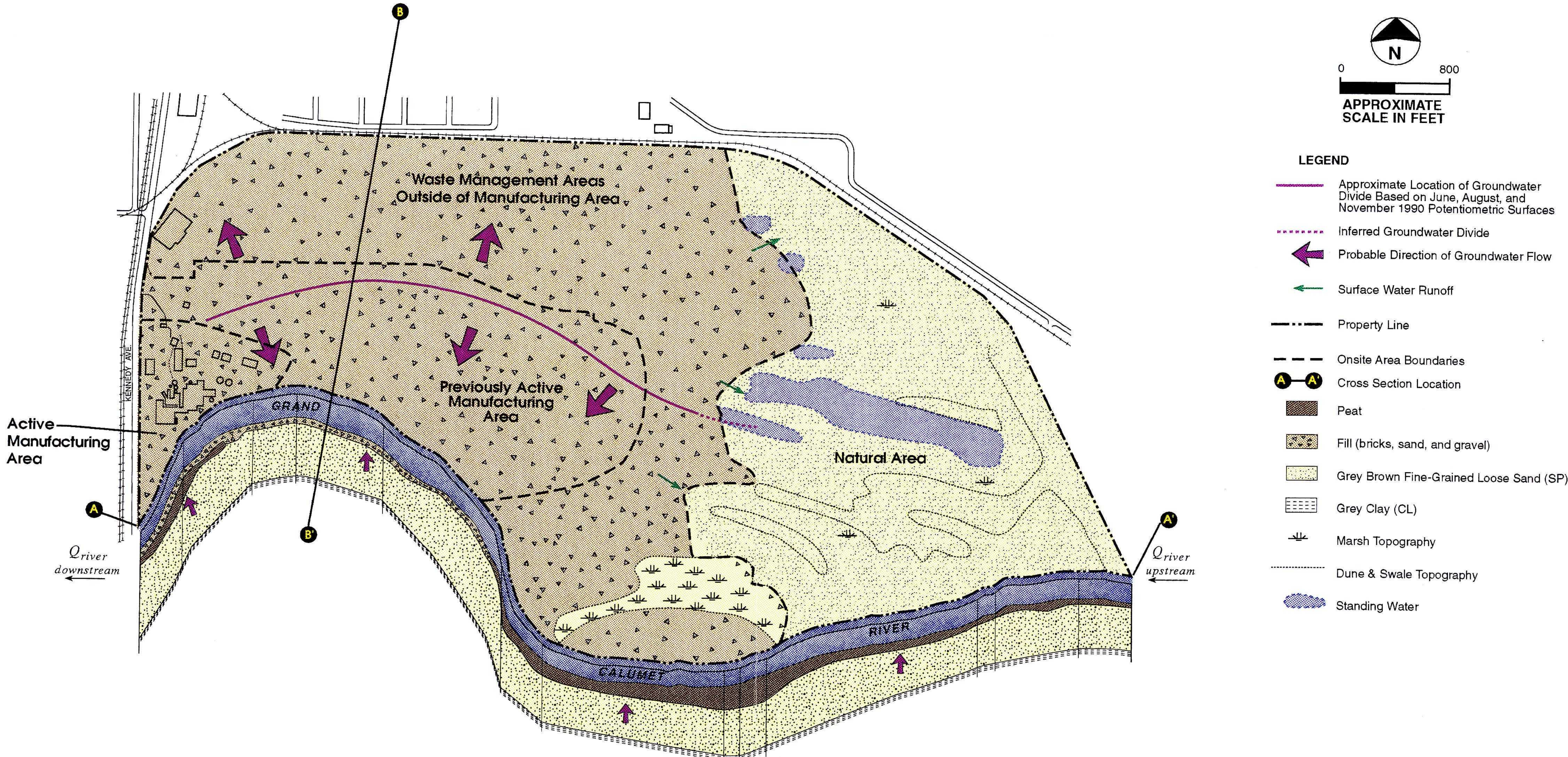
Chemical Group	Solubility	Volatility	Leachability	Bioaccumulation	Biodegradation
Tetrachloroethylene	Moderate	High	High	Low	High under anaerobic conditions, not under aerobic conditions
Toluene	Moderate	High	Moderate to high	Low	High
Trichlorofluoromethane (Freon)	Moderate	High	High	Low	Low
SVOCs					
Phenol	High	Low	Moderate to high	Low	Highly degradable
Pesticides					
Hexazinone	Moderate	Low	Moderate to high	Moderate	Low (90-day aerobic half-life reported)

Sources: Howard 1989; Hem 1992; and CH2M HILL file information.

TABLE 5-2
Resources and Species of Special Status Occurring in the DuPont Natural Area

Type	Scientific Name	Common Name	Status		Comments	Reference
			State	Federal		
P	*Betula papyrifera*	Paper birch	SR			TAMS 1991
P	*Carex aurea*	Golden-fruited sedge	ST			TAMS 1991
P	*Platanthera flava herbiola*	Pale green orchis	SR			TAMS 1991
P	*Baptista leucantha*	White wild indigo	SR			USACE 1997
P	*Carex bebbii*	Bebb's sedge	ST			USACE 1997
P	*Juncus balticus littoralis*	Lakeshore rash	SR			USACE 1997
R	*Emydoidea blandingii*	Blanding's turtle	SE	C2		TAMS 1991
B	*Botaurus lentiginosus*	American bittern	SE		Breeding evidence	TAMS 1991
B	*Ixobrychus exilis*	Least bittern	SSC		Breeding evidence	TAMS 1991
B	*Ardea herodias*	Great blue heron	WL		Observed foraging	TAMS 1991
B	*Nyciticorax nycticorax*	Black-crowned night-heron	SE		Observed in flight only	TAMS 1991
B	*Buteo lineatus*	Red-shouldered hawk	SSC		Migrant	TAMS 1991
B	*Buteo platypterus*	Broad-winged hawk	SSC		Migrant	TAMS 1991
B	*Rallus limicola*	Virginia rail	SSC		Breeding evidence	TAMS 1991
B	*Grus canadensis*	Sandhill crane	SE		Migrant	TAMS 1991
B	*Chilidonias niger*	Black tern	SE		Breeding evidence	TAMS 1991
B	*Empidonax minimus*	Least flycatcher	SSC		Breeding evidence	TAMS 1991
B	*Cistothorus palustris*	Marsh wren	SSC		Breeding evidence	TAMS 1991
B	*Vermivora chrysoptera*	Golden-winged warbler	SE		Migrant	TAMS 1991
B	*Wilsonia canadensis*	Canada warbler	SSC		Migrant	TAMS 1991
B	*Xanthocephalus xanthocephalus*	Yellow-headed blackbird	SE		Possible breeding evidence	TAMS 1991
M	*Spermophilus franlimi*	Franklin's ground squirrel	ST			TAMS 1991

P = plant M = mammal SE = state endangered ST = state threatened
B = bird SR = state rare SSC = state special concern WL = state watch list C2 = federal species at risk



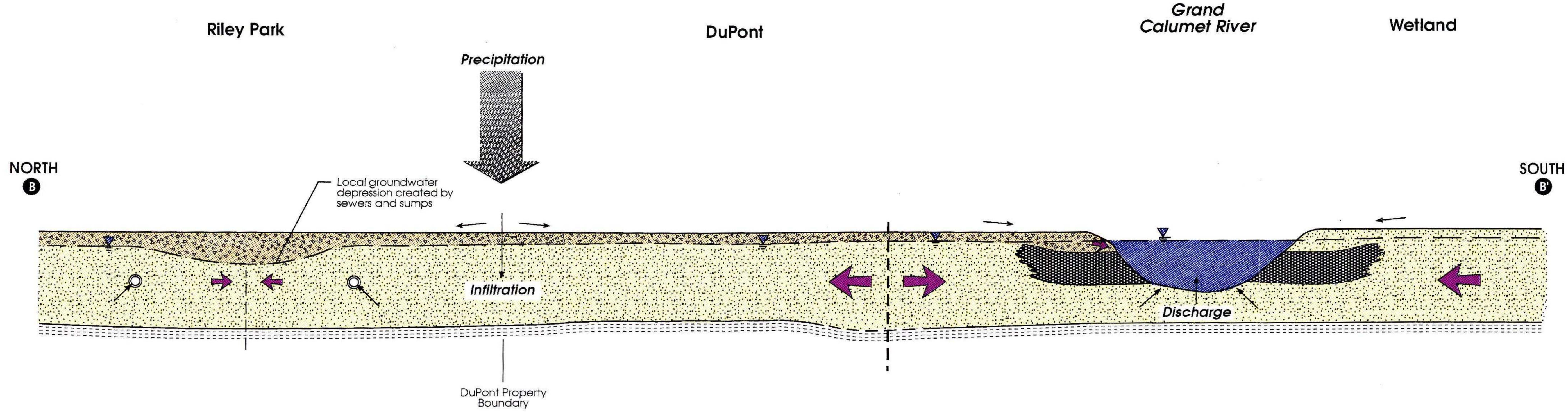
Precipitation = *Infiltration* + *Evapotranspiration* + *Runoff*

$$Q_{river\ downstream} = Q_{river\ upstream} + Q_{groundwater\ discharge} - Evapotranspiration$$

FIGURE 5-1

Conceptual View of Site Hydrology

DuPont East Chicago Current Conditions Report



LEGEND

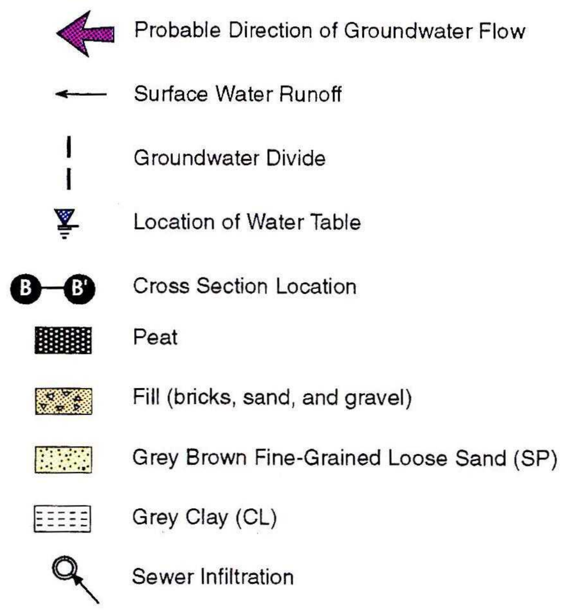
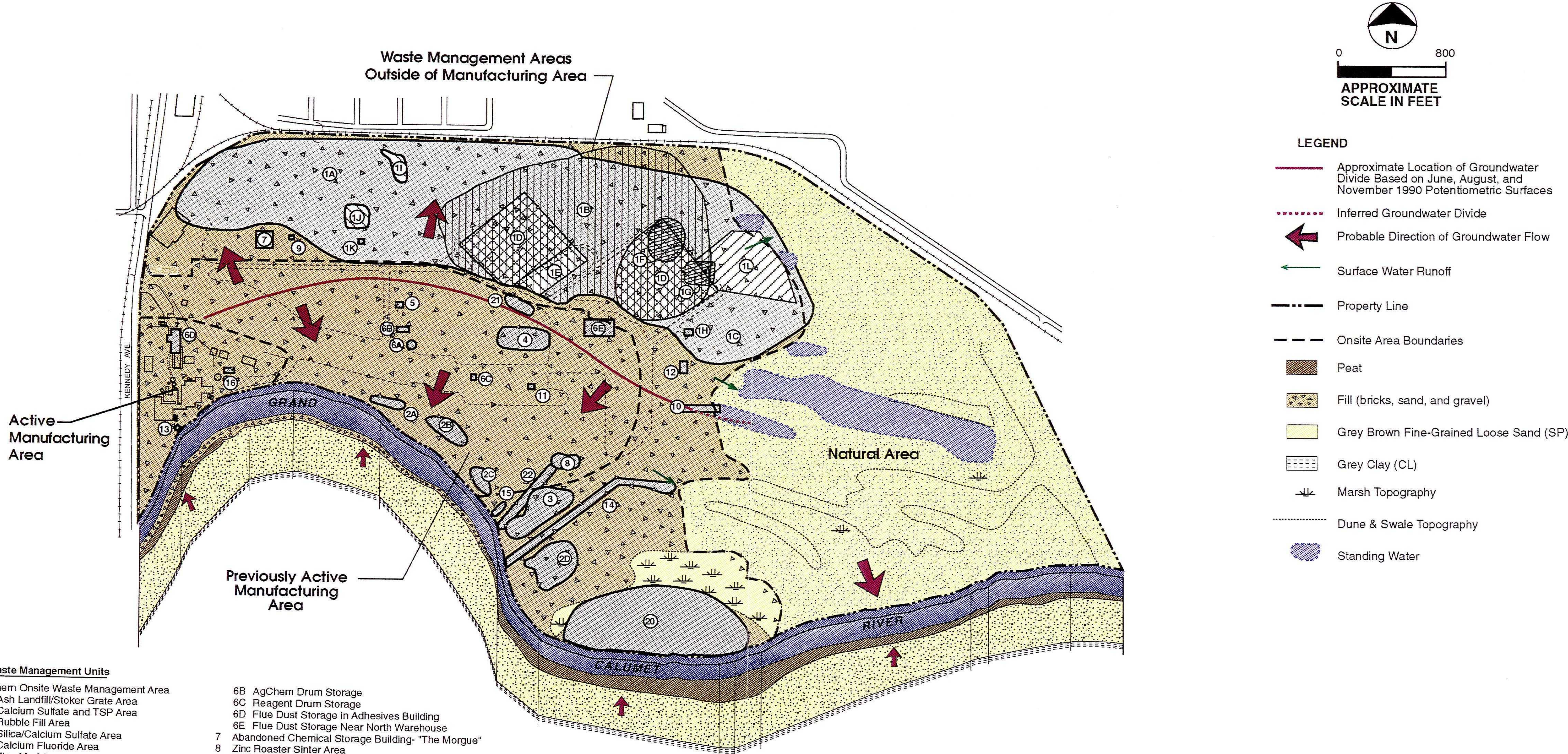


FIGURE 5-2
Section B-B'
Conceptual View of Site Hydrology
Through West Side of Site
DuPont East Chicago Current Conditions Report
CH2MHILL

E142837.EC.CC B-B' Concept View West Side 10-17-97mms/tll



Solid Waste Management Units

1 Northern Onsite Waste Management Area
- 1A Ash Landfill/Stoker Grate Area
- 1B Calcium Sulfate and TSP Area
- 1C Rubble Fill Area
- 1D Silica/Calcium Sulfate Area
- 1E Calcium Fluoride Area
- 1F Zinc Mud Area
- 1G General Rufuse Areas
- 1H PCB Storage Area in Rubble Fill Area
- 1I Miscellaneous Pits and Piles-North
- 1J Miscellaneous Pits and Piles-South
- 1K Spill Areas South of Ash Landfill/ Stoker Grate Area
- 1L New Landfill

2 Coal and Fly Ash Piles
- 2A Far West Pile
- 2B West Pile
- 2C East Pile
- 2D Far East Pile

3 Disposal Area Near Former Chrome Outfall
4 Insecticide Disposal Area
5 PCB Electrical Storage Yard
6 Hazardous Waste Storage Area
- 6A Waste Solvent Tank
- 6B AgChem Drum Storage
- 6C Reagent Drum Storage
- 6D Flue Dust Storage in Adhesives Building
- 6E Flue Dust Storage Near North Warehouse

7 Abandoned Chemical Storage Building- "The Morgue"
8 Zinc Roaster Sinter Area
9 Incinerators
- 9A Northwest Incinerator
- 9B Incinerator West of Freon Warehouse

10 HCl Neutralization Pit
11 Sulfamic Acid Pits (2)
12 Antimony Pentachloride Settling Basin
13 Colloidal Silica Settling Pits (2)
14 Former Chrome Outfall and Impoundment
15 Former Wastewater Treatment System (Outfall 002) Environmental Control System and Outfall 003
16 (Current Wastewater Treatment System)
17 Process Sewers
18 Sanitary Sewers
19 Building Maintenance Areas
20 I-90 Fill Area
21 Lead Arsenate Sludge Disposal Area
22 River Intake Canal

Note: SWMUs 17 (process sewers) and 18 (sanitary sewers) are not shown on this figure, see Figure 3-7

FIGURE 5-3
Solid Waste Management Unit Location Map
DuPont East Chicago Current Conditions Report

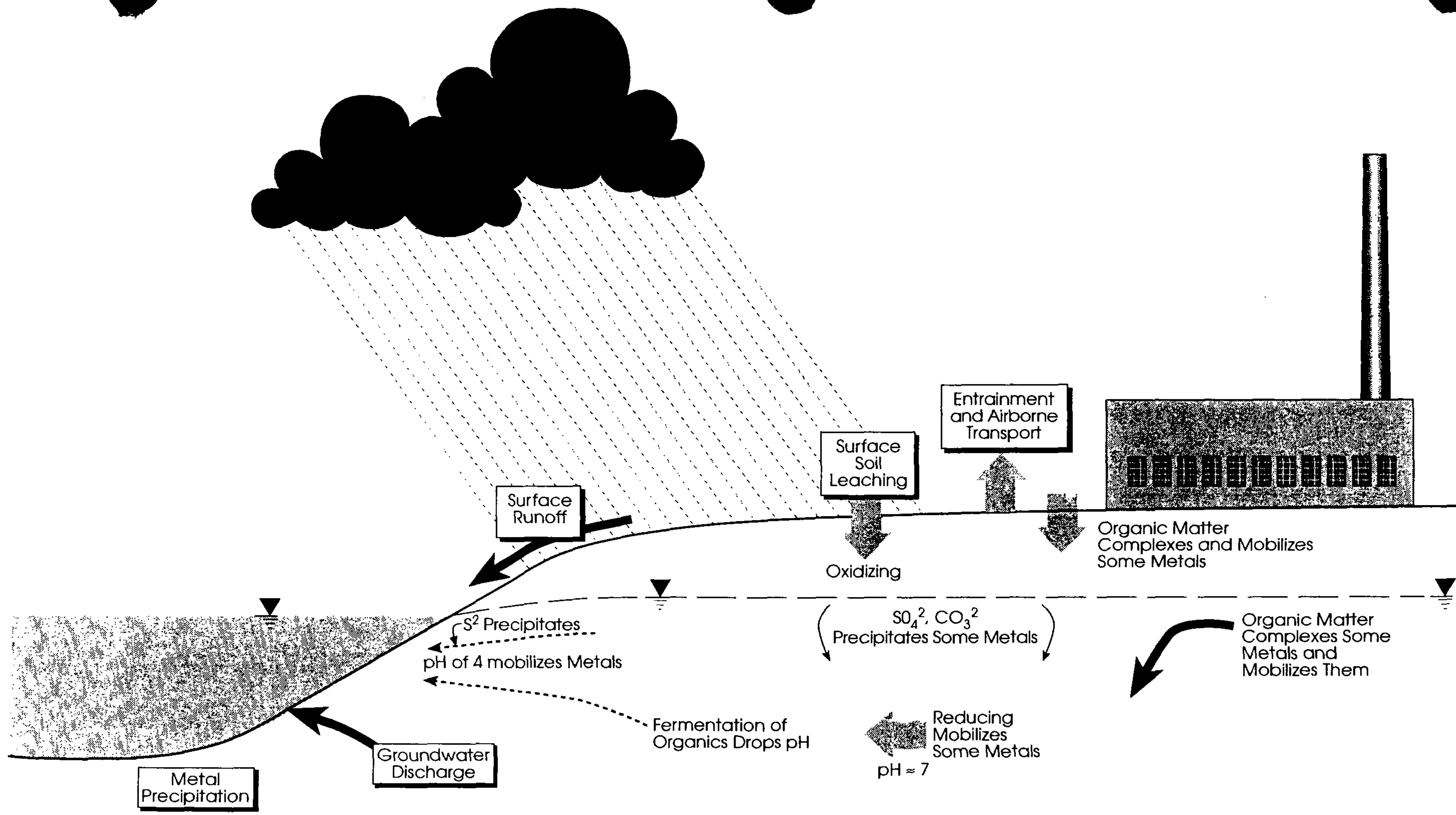


FIGURE 5-4a
Fate and Transport of Metals
DuPont East Chicago Current Conditions Report

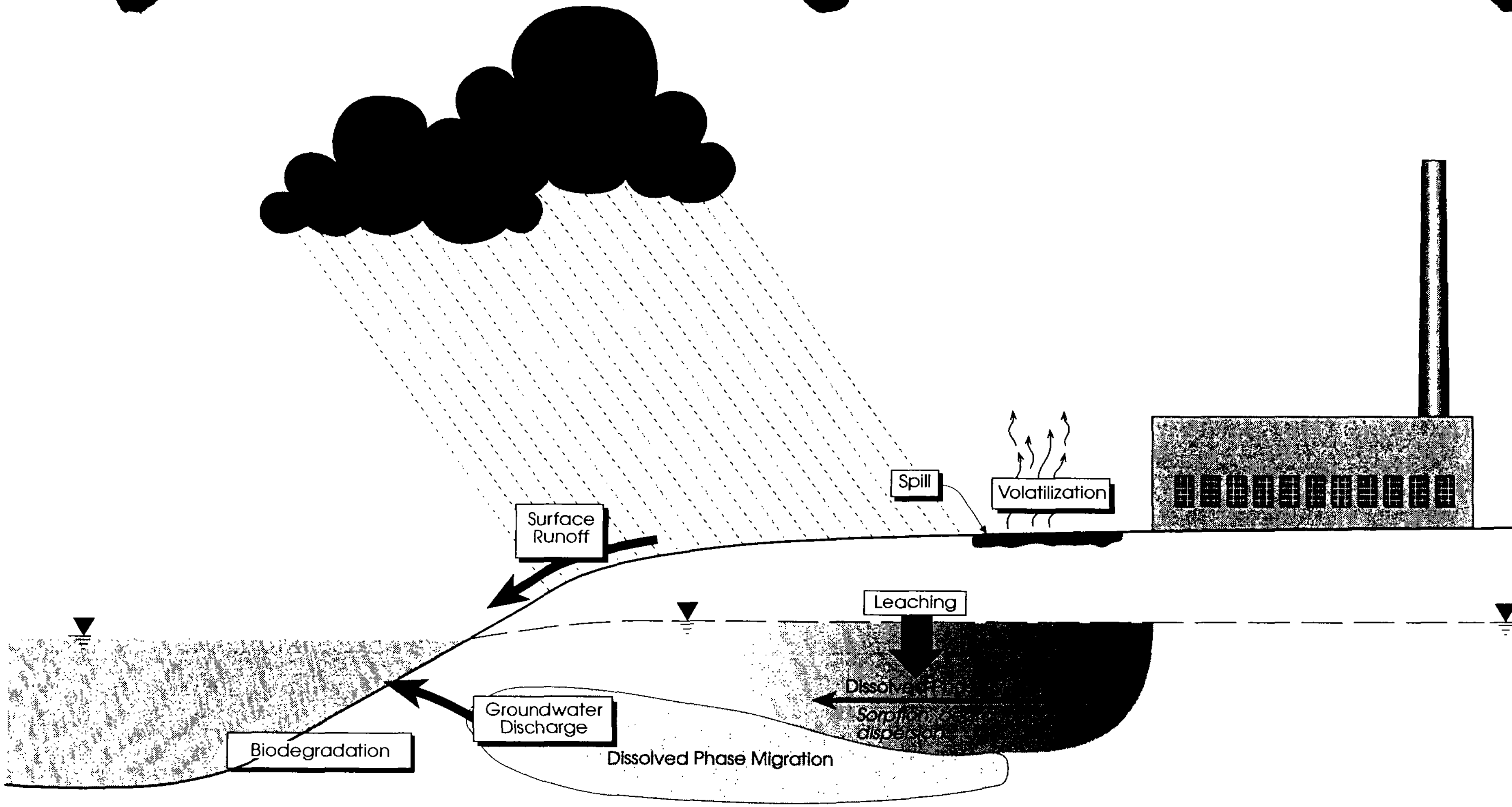


FIGURE 5-4b
Fate and Transport of Organic Compounds
DuPont East Chicago Current Conditions Report
CH2MHILL

E142837.EC.CC Fate & Transp-ORG COMPS 10-22-97mms/tll

POTENTIAL EXPOSURE CONSIDERATIONS

DIRECT CONTACT

Limited potential for direct contact with contaminated media

- Limited access to facility & contact with surface soil
- Limited direct contact with groundwater
- No groundwater use

POTENTIAL MIGRATION PATHWAYS

Groundwater

- Flow & discharge to Grand Calumet River
- Possible flow & discharge to onsite natural area
- Flow & discharge to Riley Park sewers and sumps

Surface Water Runoff

- Limited entrainment of contaminated media and potential indirect contact of significance for human & ecological receptors

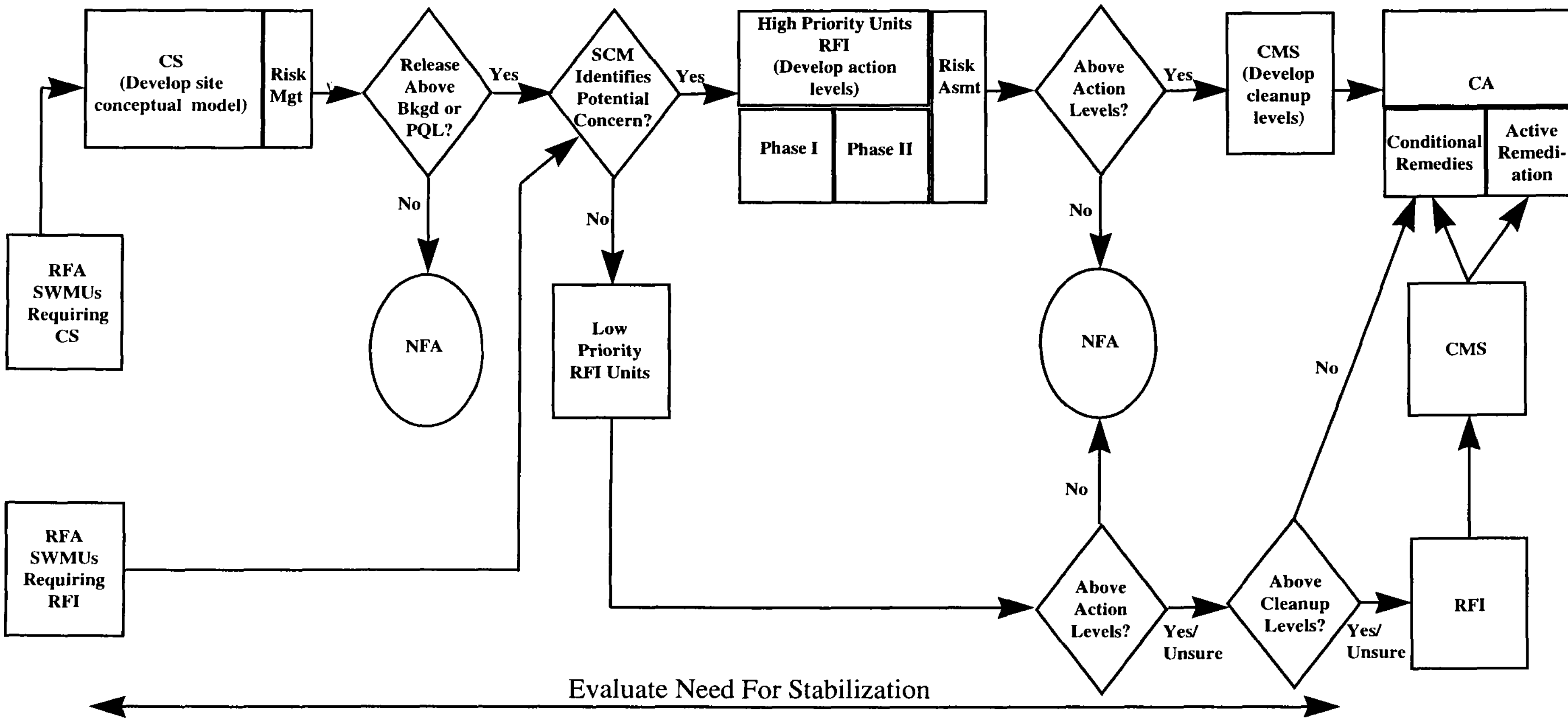
Air

- Limited entrainment of contaminated media & potential contact of significance for human & ecological receptors

PRELIMINARY FINDINGS

- No imminent threat to human or ecological health found to date

FIGURE 5-5
Potential Migration Pathways and Potential Impacts
DuPont East Chicago Current Conditions Report



AOC = Area of Concern
CA = Corrective Action
CS = Confirmatory Sampling
CMS = Corrective Measures Study
NFA = No Further Action
PQL = Pratical Quantitation Limit
RFA = RCRA Facility Assessment
RFI = RCRA Facility Investigation
SWMU = Solid Waste Management Unit
SCM = Site Conceptual Model

FIGURE 5-6
DuPont's Approach to RCRA Corrective Action
DuPont East Chicago Current Conditions Report

CHAPTER 6

References

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